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M88 Armored Recovery Vehicle

David Doyle

Walk Around®

Don Greer 2010

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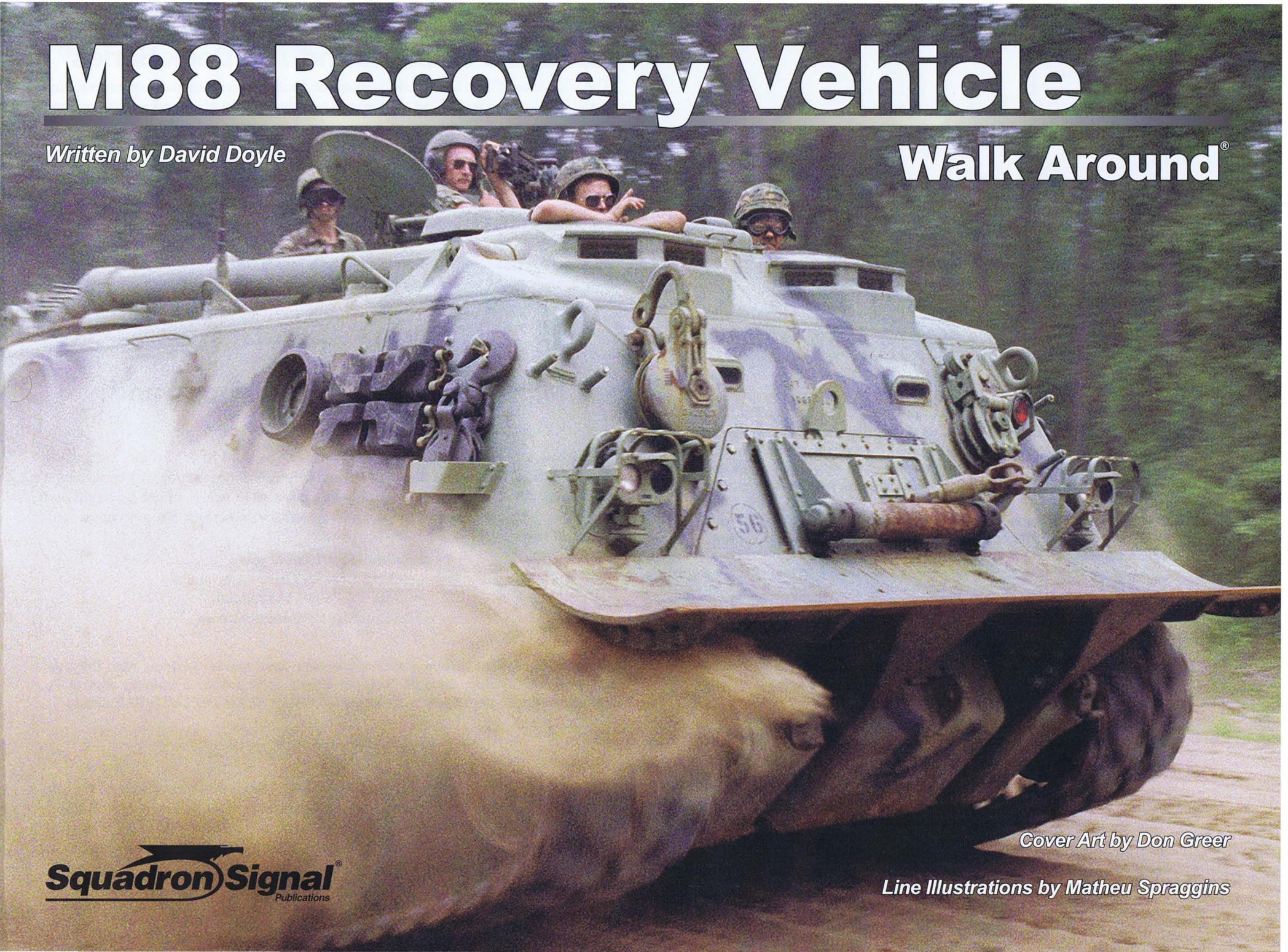
Written by David Doyle



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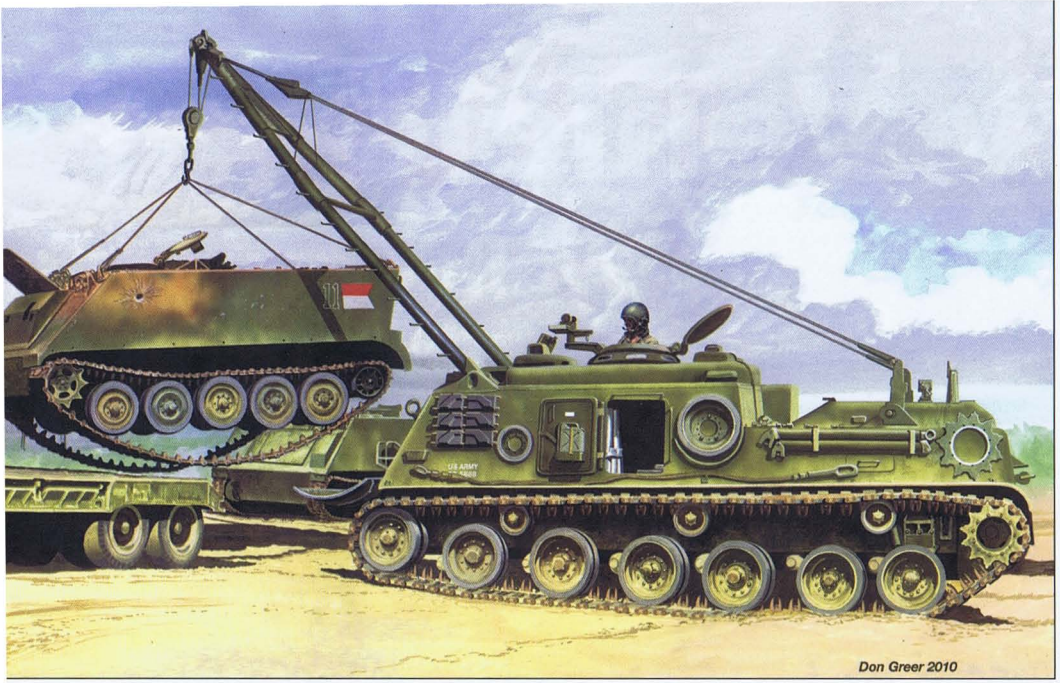
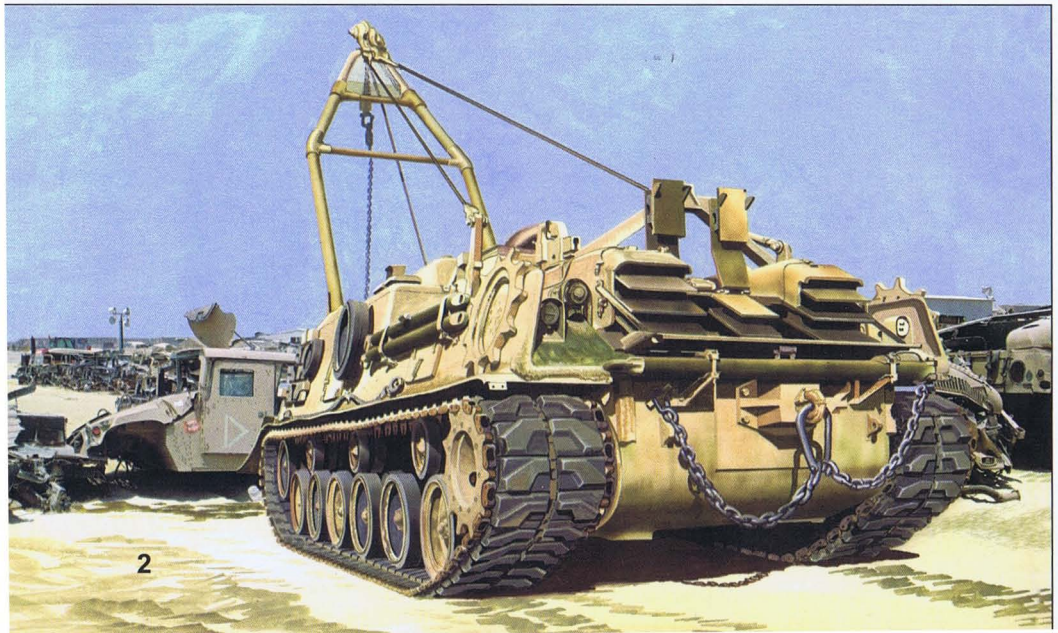


(Front Cover) An M88 lifts a disabled M113 onto a recovery trailer. The initial order for the M88 armored recovery vehicle was placed in 1959. By the time that U.S. armored forces were on the ground in Vietnam, the M88 was the standard recovery vehicle, and also the largest and heaviest armored vehicle operated by the U.S. Army in that country.

(Back Cover) Remarkably, more than 30 years later when U.S. troops went into the Mideast in Operation Desert Storm, the M88A1, a Diesel-powered variant, was still America's primary armored recovery vehicle.



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(Title Page) An M88A1 armored recovery vehicle from the 1st Platoon, 48th Brigade, 108th Armored Division, Georgia National Guard, rolls toward a training area at Ft. Stewart, Georgia, to participate in Exercise COMPANY TEAM DEFENSE. (U.S. Army)

Acknowledgments

This book would not have been possible without the generous assistance of the late Jacques Littlefield and the Military Vehicle Technology Foundation; Chris Hughes; Michael Green; Tom Kailbourn; John Adams-Graf, Verne Kindschi; and the staff of the TACOM History Office. Special thanks to Denise – who patiently inspires me to persevere – and the veterans who crewed these vehicles.

All photos by the author unless otherwise noted.

Introduction

As tanks grew bigger and heavier over time, the need for specialized recovery equipment increased. Through the 1940s and 1950s, the U.S. Army relied on armored recovery vehicles based first on the M3 Medium Tank, and later the M4 family of medium tanks. The latter reached its zenith with the M74. Plans for a new generations of tanks were in place, and it was evident that the M74 would be overburdened. An armored recovery vehicle based on the components of the M103 heavy tank, designated the M51, was developed, but it was huge, and placed a considerable burden on the logistics system, and like the tank upon which it is based, was produced only in limited numbers.

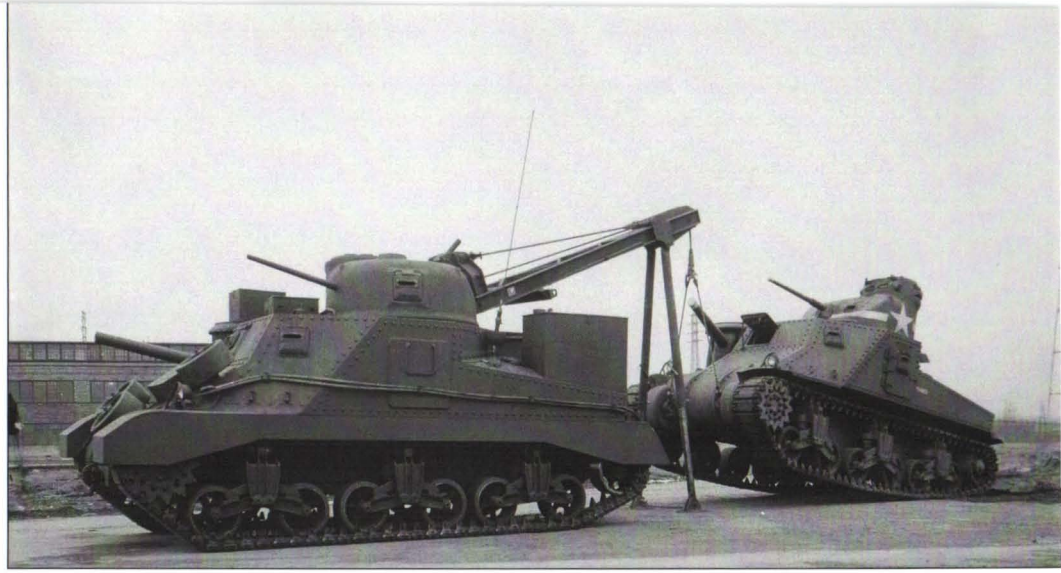
Hence, yet another vehicle was developed. Designated M88, this vehicle combined the power plant of the M51, suspension components of the M48, and an all-new hull and recovery system. Bowen-McLaughlin-York Inc., of York, Pennsylvania, developed the vehicle and was awarded a contract for 1,075 of them in 1959. Remarkably, the standard armor recovery vehicle (ARV) of the U.S. Army as of 2010 is the M88A2, an updated version of the 1959 model.

The original, gasoline-powered M88 served admirably in Vietnam. In the 1970s, however, the army began a move toward an all-Diesel tactical vehicle fleet, and accordingly the M88 retrievers were re-engined with Diesel powerplants. At the same time, a Diesel-powered Auxiliary Power Unit (APU) was installed. The Diesel-powered retriever was classified as the M88A1, and is readily distinguished by the APU's grille just behind the right side door of the retriever.

M88A1 production ended in 1989, after 3,042 had rolled off the line. The tooling was placed in storage, and BMY even had the foresight to cast and store some extra hulls. These allowed a quick restart of production to meet foreign orders in 1991. The design of the armored hulls is similar to those of a tank, and, as mentioned, many of the suspension and drive train components are common to the M48/M60 Medium Tanks that were its contemporaries.

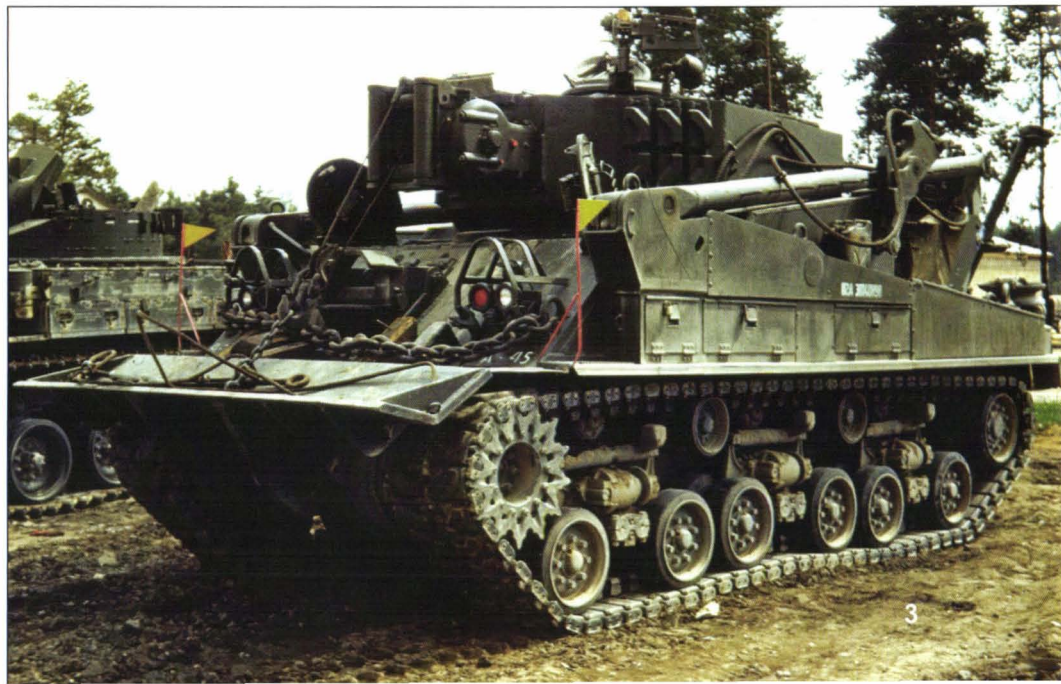
The lower portion of the cast-armor hull is occupied by two hydraulically powered winches – one to operate the hoist, and a massive 90,000-lbs capacity main recovery winch. The recovery winch, mounted near the front of the vehicle, is wrapped with 200 feet of 1.25-inch diameter wire rope. The hoisting winch is used in conjunction with a hydraulically raised A-frame boom and is equipped with 400 feet of 5/8" wire rope. The winch is rated with a 50,000-lbs. capacity when the front ground spade is lowered. There are, however, several films showing two M88s being used in concert in Vietnam to lift an M48 and drive, tank dangling, to a recovery trailer, onto which the tank is then lowered. The hoist winch is mounted near the center of the vehicle, beneath the floor plates.

Other equipment incorporated in the design include a hydraulically-driven heavy duty impact wrench, a hydraulically operated refueling pump, and the bow-mounted blade. This blade was to be used primarily for stabilizing the vehicle during heavy lifts, and as a ground anchor during heavy winching operations. It could also be used for minor earth work in conjunction with recovery operations, but despite the use by some crews, was specifically not for use in heavy earth moving such as preparing defensive positions.



An early U.S. design for a tank recovery vehicle was the T2, shown here using the boom and stiff legs to lift the front end of an M3 medium tank, upon which the T2 design was based. The T2's maximum lifting capacity of 30,000 pounds was later dwarfed by the 50,000-pound capacity of the M88 tank recovery vehicle. (U.S. Army Transportation Museum)

The M74 medium recovery vehicle was a postwar design based on the M4A3 medium tank. Produced by Bowen-McLaughlin-York, the vehicles had a collapsible boom with a 25,000-pound lifting capacity, a towing winch with a 90,000-pound capacity, as well as several auxiliary winches. The concept of the spade for bracing the front end during heavy lifting operations was later applied to the M88. (Verne Kindschi)

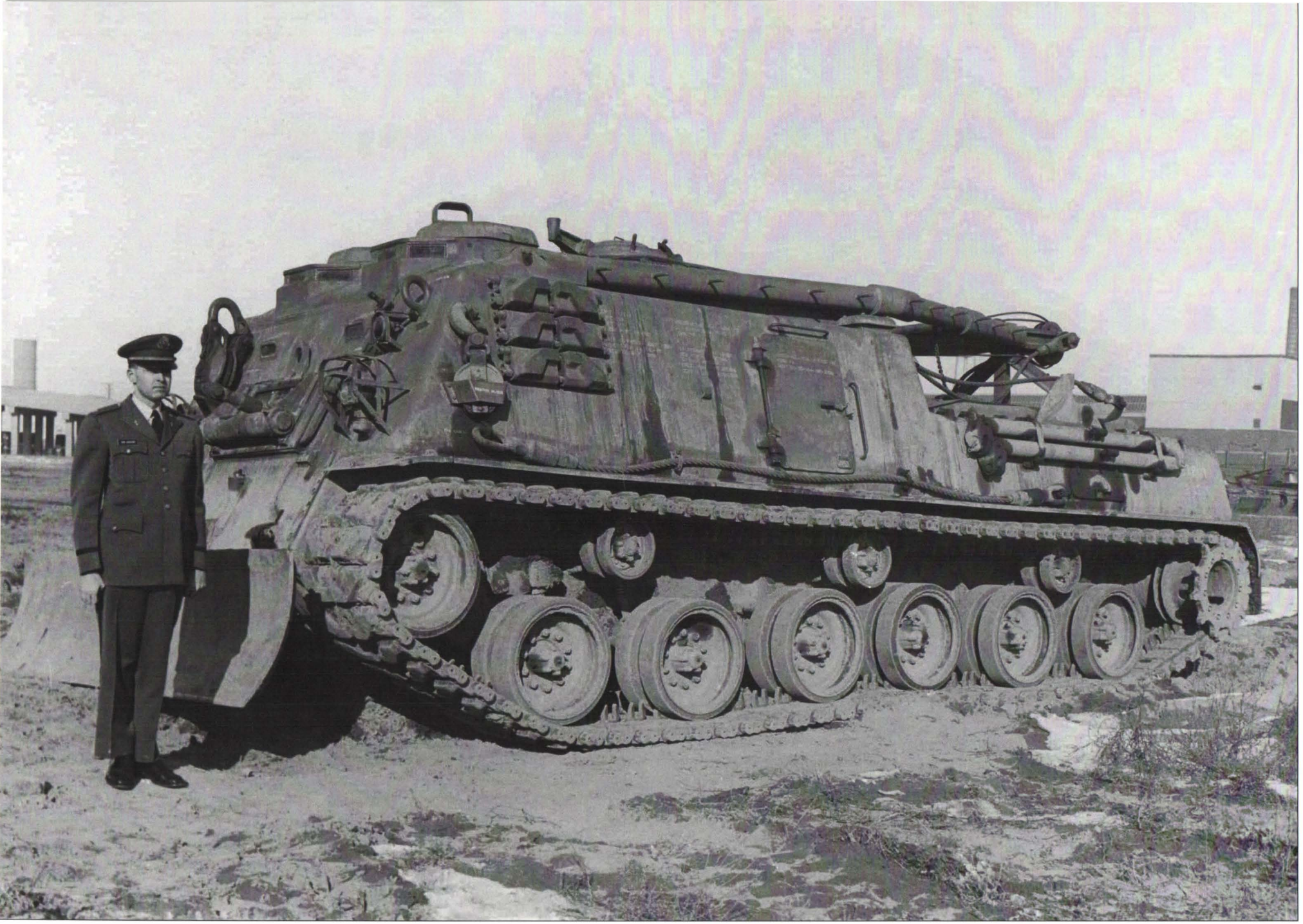


The M32-series recovery vehicles saw heavy use in World War II and the Korean War. Based on several versions of the M4 medium tank, they had a tubular boom pivoted near the front of the hull and a winch in the center of the vehicle. Rated at 60,000 pounds, the Gar Wood 6M814 winch could recover any U.S. Army vehicle at the time the M32 was introduced. The boom served many lifting duties. On the glacis was a roller assembly for routing a dragline to the front of the vehicle. (The Patton Museum)

The M51 heavy recovery vehicle, developed in the early 1950s, was based on the M103 heavy tank. It featured a 30-ton crane mounted behind the crew compartment and a hydraulic main winch rated at 45 tons capacity. Like the earlier M74 and the later M88, it had a stabilizing spade at the front of the vehicle; it also had a spade at the rear of the hull. (The Patton Museum)

The M728 combat engineer vehicle was based on the M60 tank. At one time consideration was given to combining the roles of tank recovery vehicles and combat engineer vehicles. Features included a turret-mounted boom rated at a hoisting capacity of 17,500 pounds with a 360° traverse; a hydraulically operated, 146"-wide bulldozer blade; a two-speed hydraulic winch, and a 165mm M135 short-barreled gun for demolition. From 1966 to 1972, 243 of these vehicles were manufactured. (TACOM LCMC History Office)

Ultimately, the M88 design would, with improvements, remain the Army's standard recovery vehicle for over five decades. This M88 tank recovery vehicle is owned and preserved by the Military Vehicle Technology Foundation. (Jacques Littlefield)



This file photo of an M88 was taken during tests by the Detroit Arsenal on 9 February 1961. The spade is in a partially lowered position, and the vehicle is heavily streaked and spattered with mud. Extensive stencilings are visible, especially on the side of the vehicle. (TACOM LCMC History Office)

The compensating idler wheels (the left one is shown here) at the front of the vehicle have rubber tires. There is a lubricating fitting on the top of the hubcap. A shock absorber for the front road wheel appears to the rear of the idler. The two forward and the rearmost road wheels on each side of the M88 are fitted with shock absorbers.

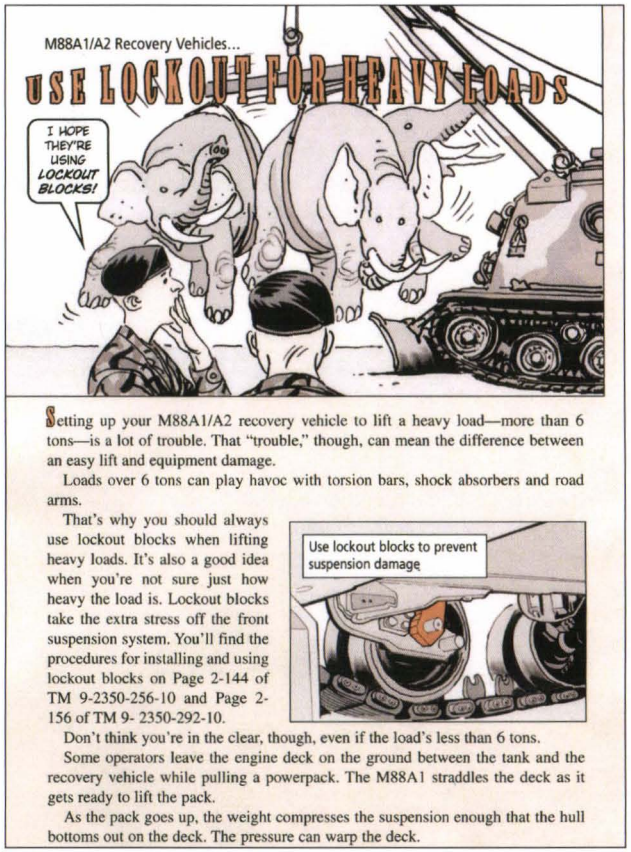
Between the left idler wheel (left) and front road wheel (right) is the track tightening arm (also called the compensating idler link), which adjusts the idler forward or backward to adjust the tension of the track. Above the road wheel is a volute bumper spring assembly; these are mounted above the road wheel arms of the number one and number six road wheels on each side.

Introduction, continued from page 3.

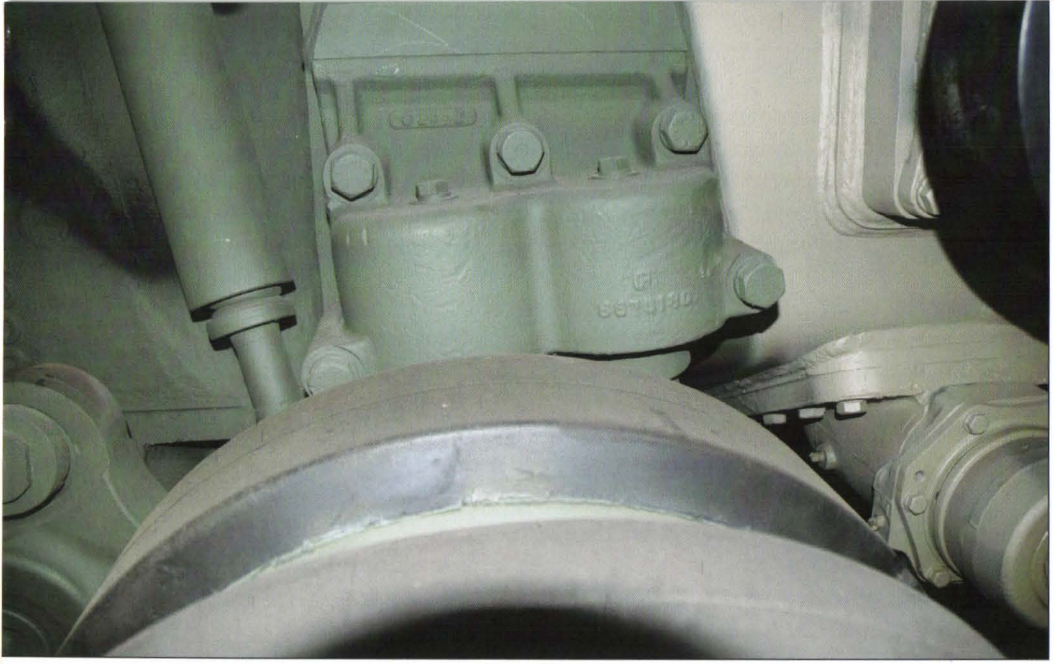
The crew of a M88 consists of four men. In addition to the commander, whose position is near the center of the vehicle, the crewmen include a driver/operator, a mechanic, and a rigger. In addition to the cupola-mounted M2 HB machine gun, the crew of the M88 was provided with a number of LAW rockets and submachine guns.

When new, the M88 was among the heaviest armored vehicles in the American arsenal, almost a necessity for safe recovery operations. With the advent of the M1 Abrams, the M88A1 was at last faced with more tank than it could safely recover in a timely fashion. Due to concerns that the heavier Abrams would push the retriever around, it was required that two M88A1s, or an M88A1 and a second Abrams, be used to recover a dead Abrams – the second vehicle being towed behind the dead tank to act as a brake. This prevented the disabled tank from overtaking the M88A1.

To answer this logistical nightmare, another improvement was made to the M88 family. Dubbed the Hercules, the M88A2 was created by rebuilding older vehicles with more powerful engines, brakes, winches, lifting apparatus, suspension and armor protection. A single Hercules can safely recover an Abrams, thus the five-decade old design is expected to soldier on for years to come.


M88A1/A2 Recovery Vehicles...
USE LOCKOUT FOR HEAVY LOADS
I HOPE THEY'RE USING LOCKOUT BLOCKS!
Setting up your M88A1/A2 recovery vehicle to lift a heavy load—more than 6 tons—is a lot of trouble. That "trouble," though, can mean the difference between an easy lift and equipment damage.
Loads over 6 tons can play havoc with torsion bars, shock absorbers and road arms.
That's why you should always use lockout blocks when lifting heavy loads. It's also a good idea when you're not sure just how heavy the load is. Lockout blocks take the extra stress off the front suspension system. You'll find the procedures for installing and using lockout blocks on Page 2-144 of TM 9-2350-256-10 and Page 2-156 of TM 9- 2350-292-10.
Use lockout blocks to prevent suspension damage
Don't think you're in the clear, though, even if the load's less than 6 tons.
Some operators leave the engine deck on the ground between the tank and the recovery vehicle while pulling a powerpack. The M88A1 straddles the deck as it gets ready to lift the pack.
As the pack goes up, the weight compresses the suspension enough that the hull bottoms out on the deck. The pressure can warp the deck.

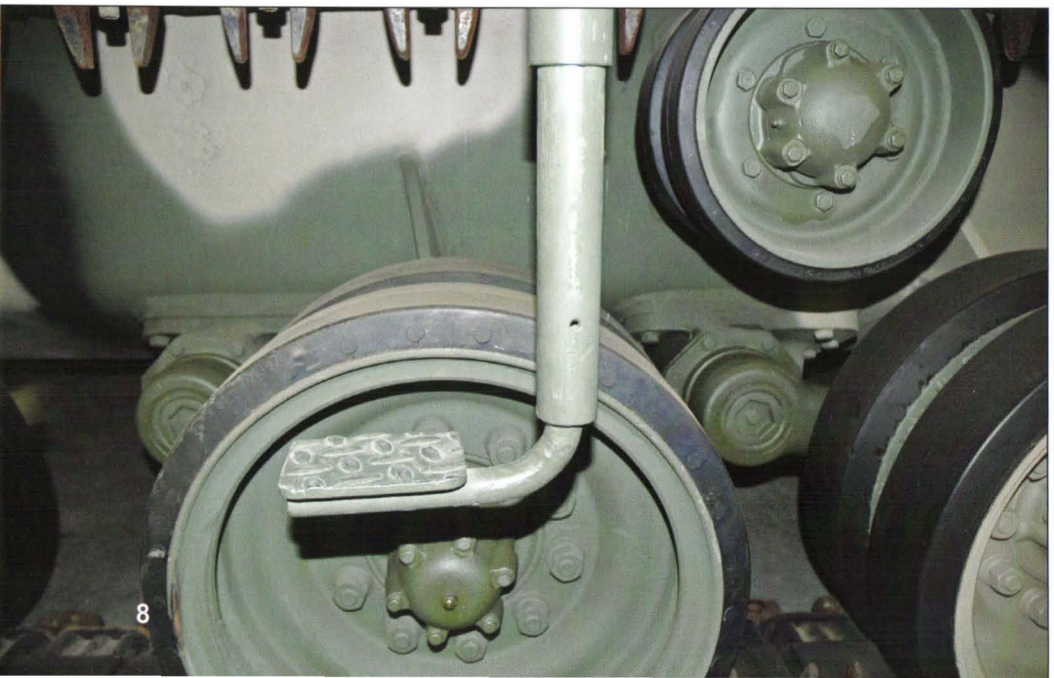
This instructional sheet stressed the importance of placing lockout blocks on the front suspension arms to prevent serious damage to the suspension when using the boom to lift loads in excess of six tons. The lockout blocks acted as locks to immobilize the bogie arms.



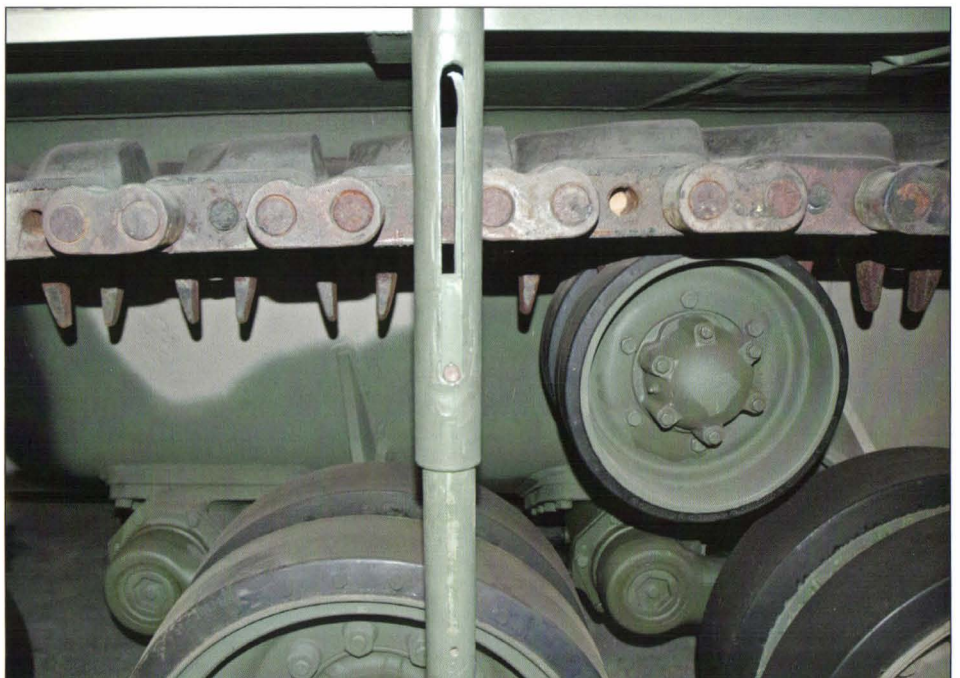
Shock absorbers are mounted on the numbers one, two, and six suspensions on each side. To the upper right is the edge of the forward left track support roller (often called return roller). Part numbers are cast on the bumper spring assembly.

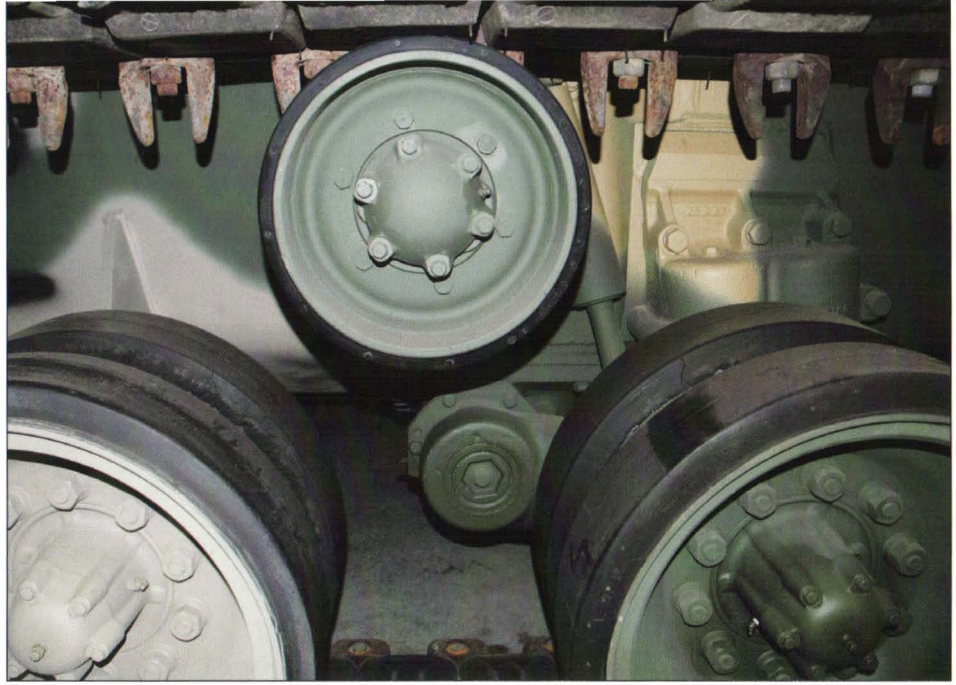
The bumpers with dual springs provide secondary springing action for the front and rear road wheels, supplementing the action of the torsion bars.

Extending from each crew compartment door is a collapsible, fold-up step. The tread pattern on the footpad of the lower part of the left step is visible here. Like the bogie wheels, the return rollers, or track support rollers, have rubber tires. Track guides are visible at the top left.



The upper part of the personnel step shows the grooves for the lugs that limit the downward travel of the lower tube. Visible in profile above the top of the road wheel at the center is the upper part of the bump-stop bracket, mounted over the road wheel arms of the numbers two through five road wheels, to limit the arms from flexing upward beyond acceptable limits.



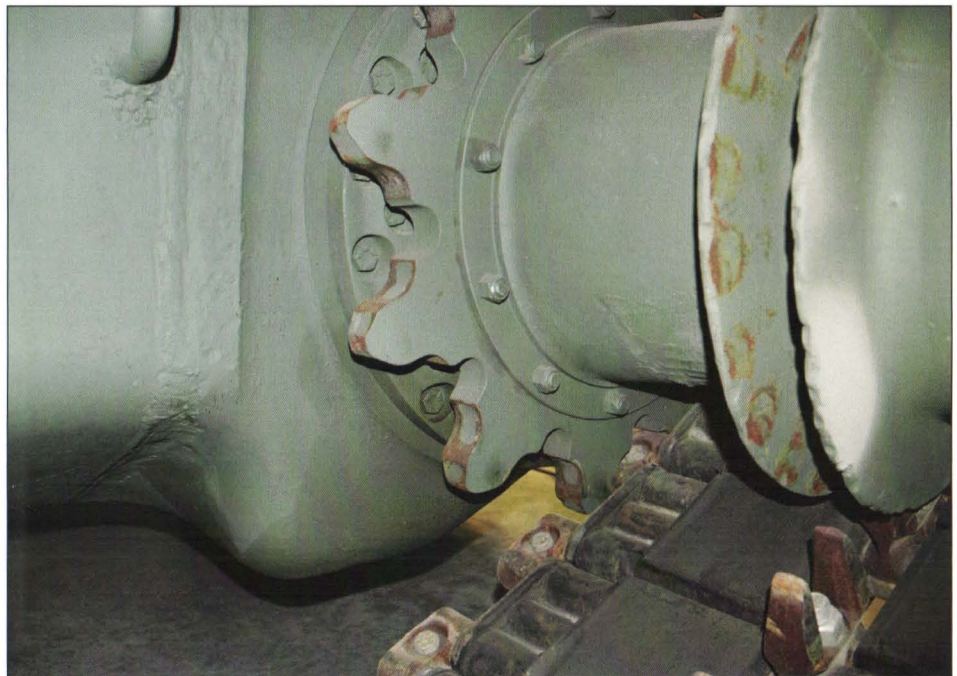


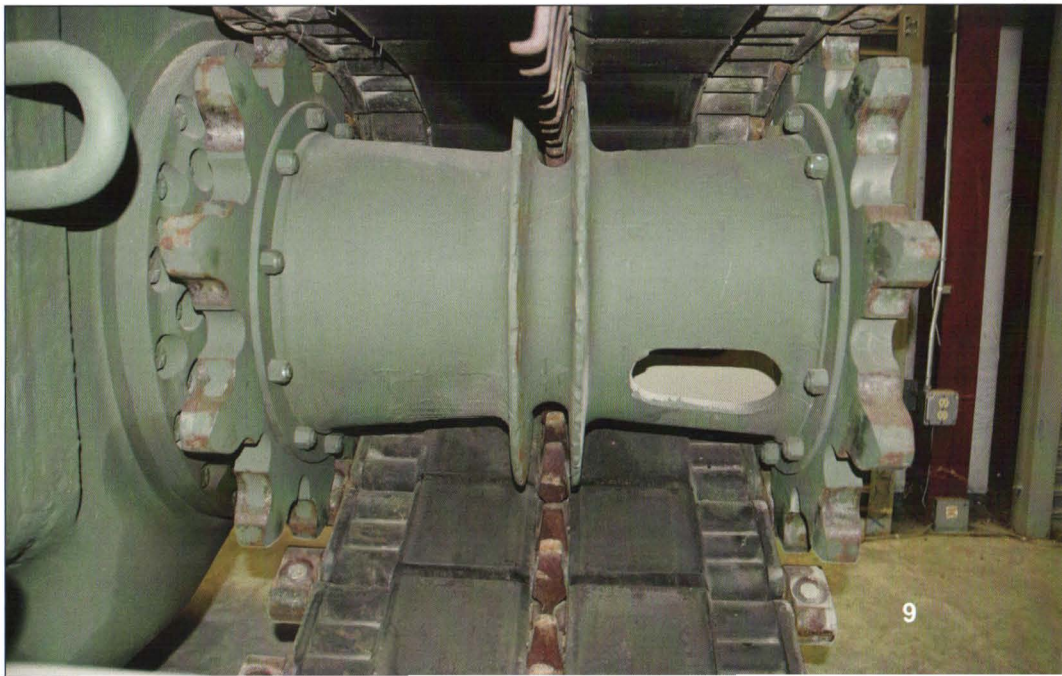
The center-left return roller seen here is one of the three return rollers on each side of the M88. Bolted to the inside of the track between each track shoe is a center guide. To the upper right is the compensating idler link.

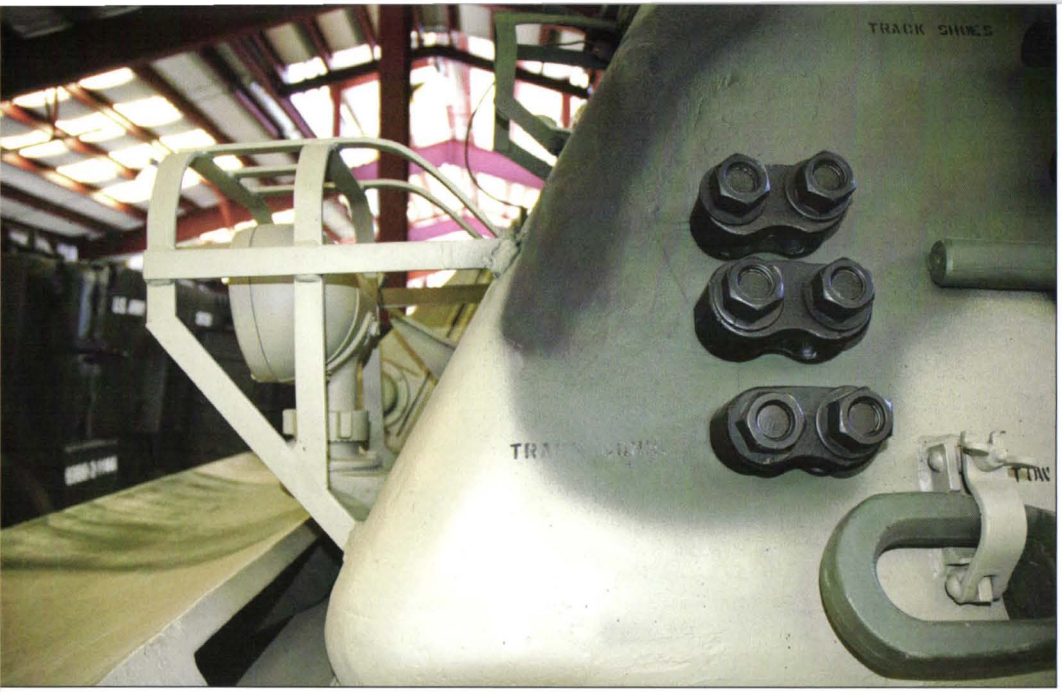
Three elongated holes are incorporated into the outer part of the drive sprocket hubs. Details of the left rear fender and mud flap are also visible.

The inner part of the sprocket hub shows the channel at the center for engaging the track guides. At the top is the rear tie-down eye. There are four of these on the lower hull, for securing the vehicle to a transporting vehicle.

The nuts securing the sprockets to the hub are visible and there is a clear view of how the track guides fit into the channel at the center of the hub. To the left is the left output reduction drive, with numerous countersinkings on the face for the recessed locking nuts that secure the mechanism to the hull.

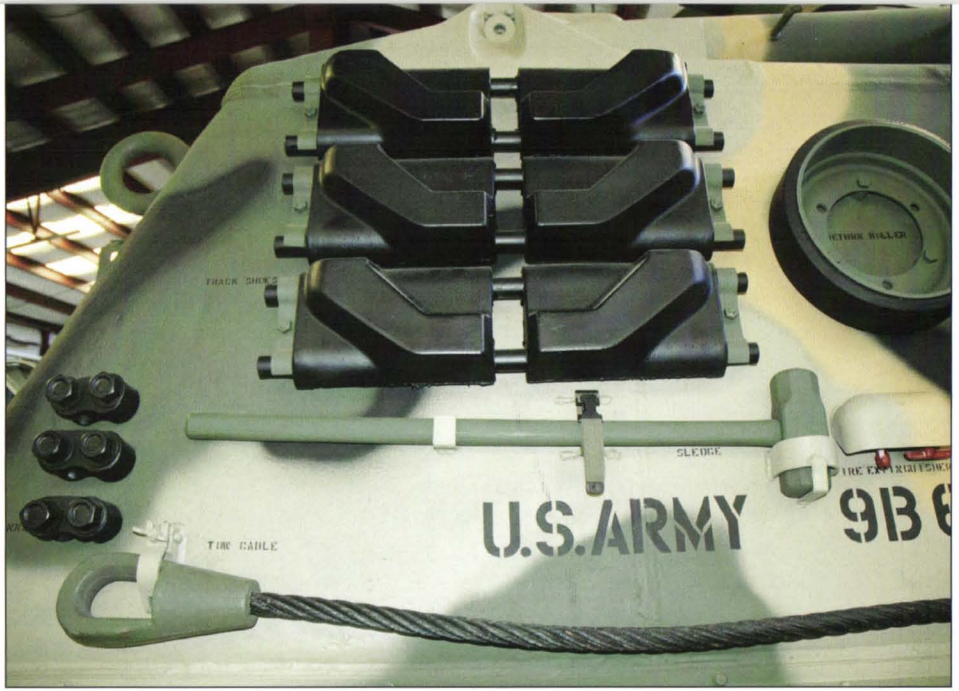






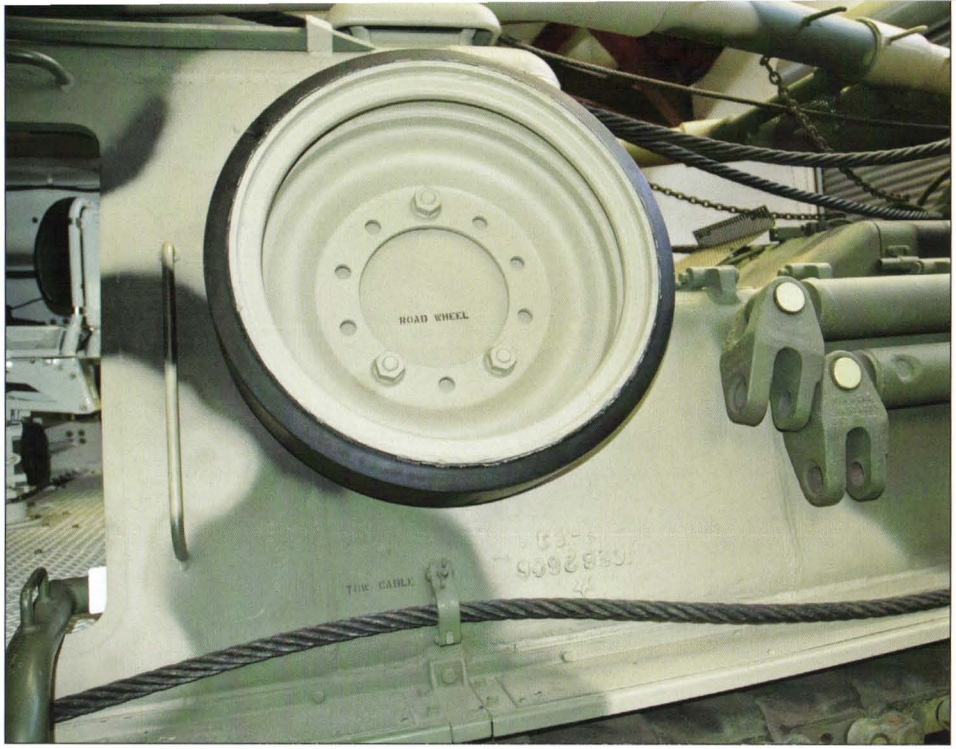
Three stored track end connectors are mounted on the front end of the left side of the hull. To the left are the left headlight and brush guard assemblies.

Moving slightly towards the rear, the left crew compartment door is open, revealing the olive drab paint used on the interior of the door, as well as the five-gallon liquid container and holder. Standard stencilings identify storage points on the interior and exterior of the vehicle.

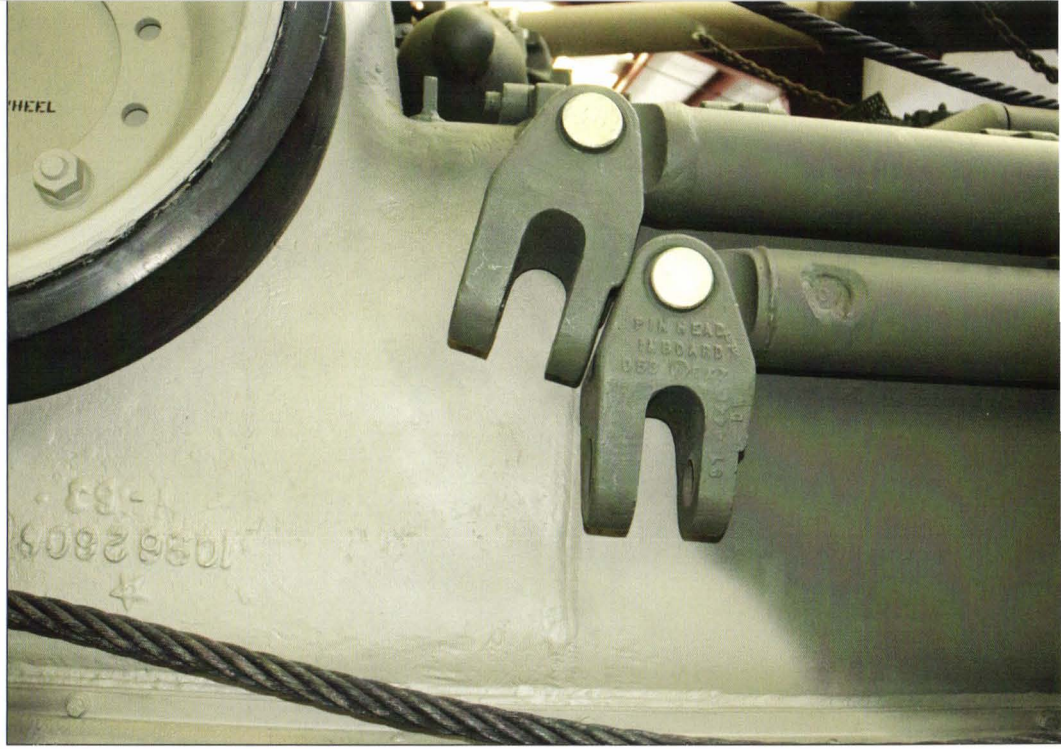


Track shoes, a return roller, sledge hammer, and a tow cable are stored on the left front of the vehicle. The housing below the return roller contains a pull-handle for actuating the interior fire extinguisher.

The crew compartment appears through the open left door. Overhead is the vehicle's boom, with rungs. To the right is a spare road wheel. There is a fire extinguisher in a clamp-type bracket fixed inside the door.

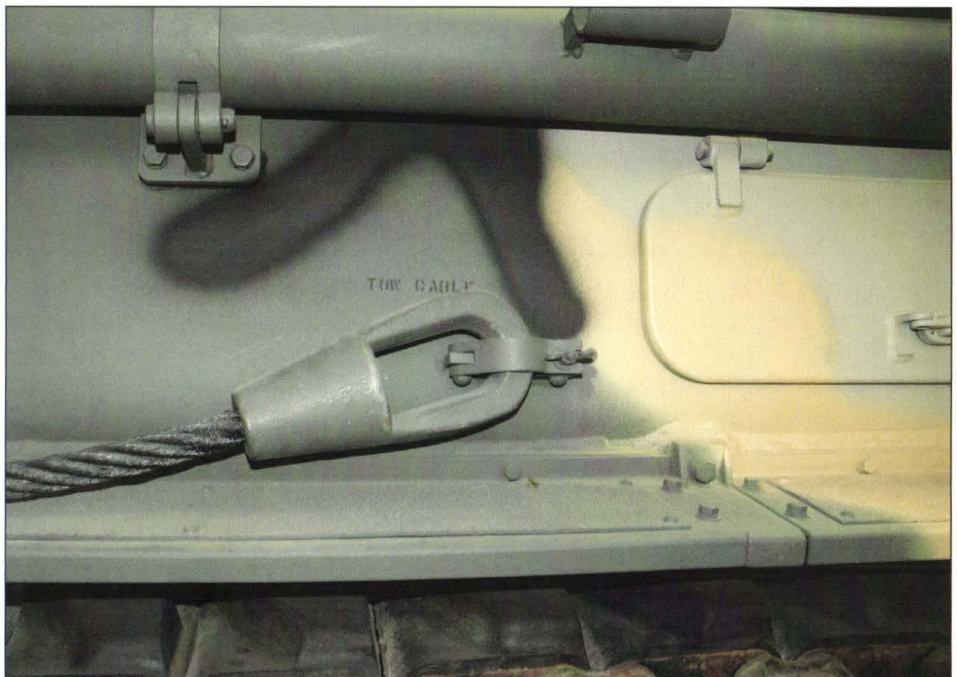


A spare road wheel is fixed to the rear of the left door, with the boom above, and a tow cable clamp below the wheel. Part of a tow bar is to the right.

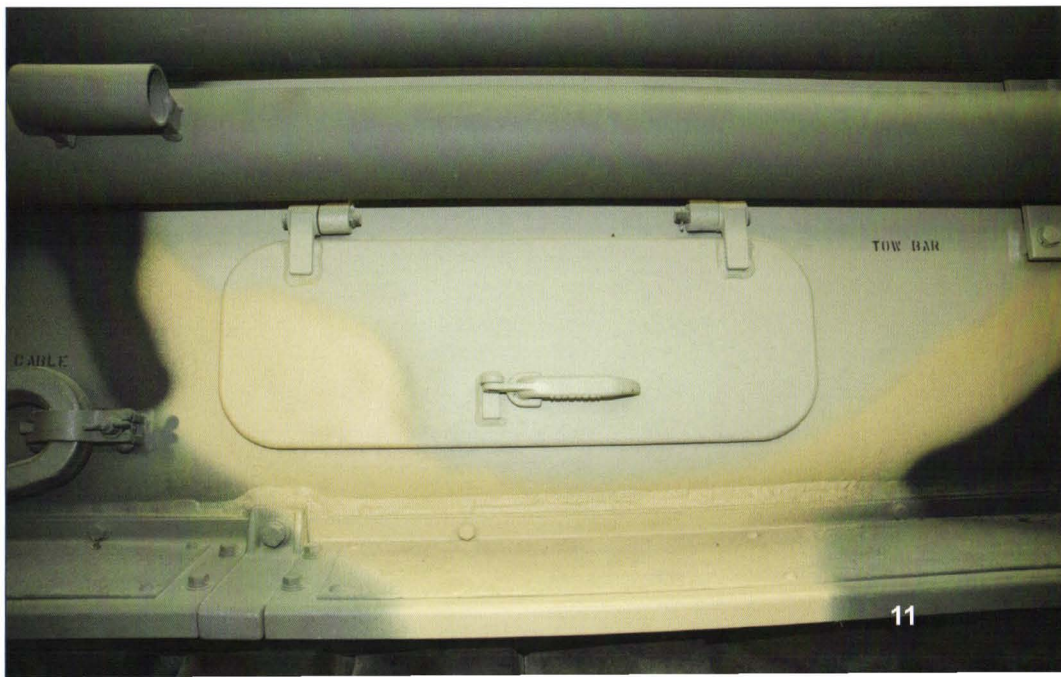


The tow bar has pivoting attachment points. Casting numbers are visible on the hull below the stored road wheel.

The tow cable is in its storage clamp on the left side of an M88 hull, with the lower half of the tow bar and a storage bracket above it. There are non-slip panels on the fender.



This door on the left rear side of the hull covers a small compartment where chains and other gear are stored.

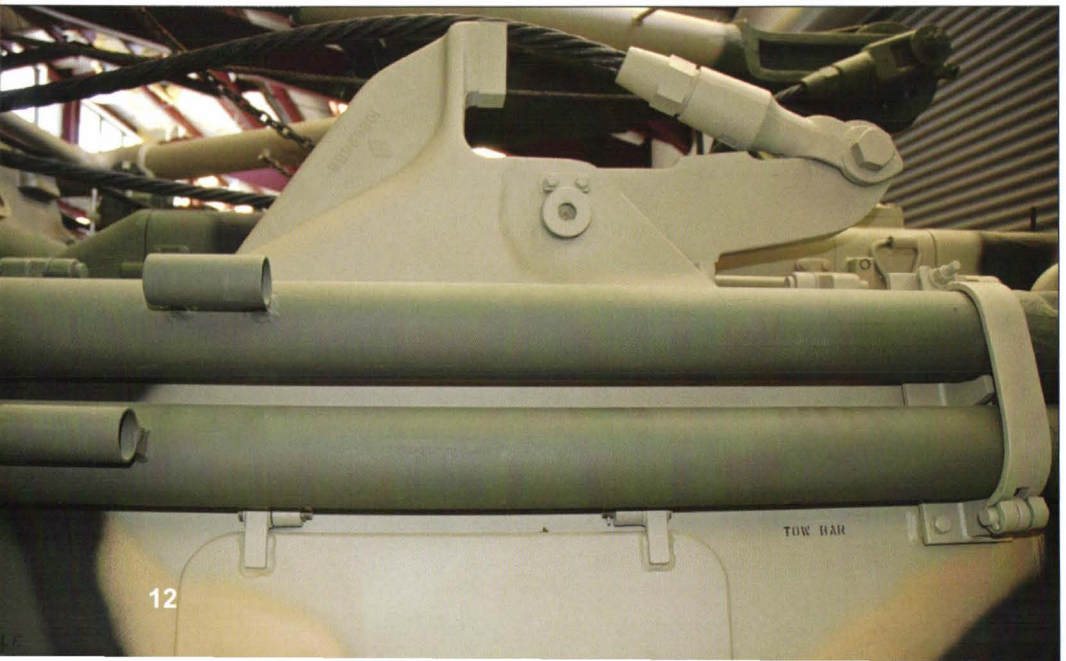


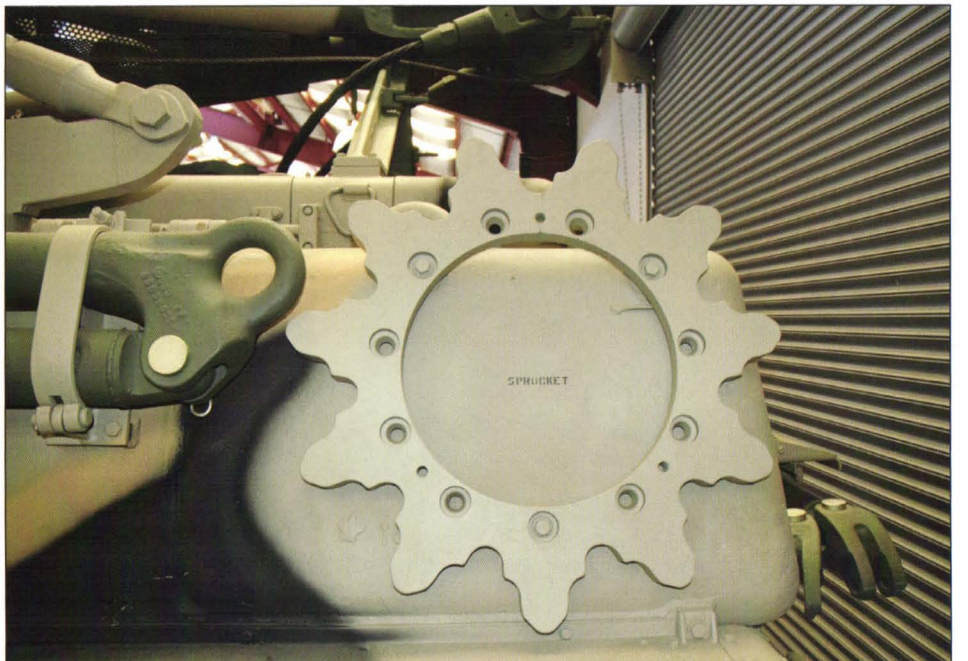
The crew of this M88, photographed at Camp Beavers, Korea, on 12 January 1971, has painted the towing shackles and lifting eyes on the front of the vehicle yellow, making them stand out against the olive drab hull of the FS595A 24087. (National Archives)

A stay cable is fastened to the left crank arm assembly, seen above the tow bar. The apex of the lowered boom appears to the upper right of the photo.

On 1 November 1965, Saigon witnessed a parade marking the second anniversary of the overthrow of the Diem Regime in 1963. Taking part was a U.S. First Infantry Division M88 that led a LARC V along a city street. (National Archives)

An extra sprocket is bolted to the left rear of the hull. To the left of it is the center pivot and towing eye of the tow bar.





An M88 deploys to pull an M48A3 tank (not visible) from a deep creek bed north of Fire Support Base Bandit II in Vietnam during late November 1970. The left rear mud guard is missing, allowing the track to throw clumps of mud on the rear fender and hull. A considerable amount of additional external stowage has been added to this vehicle. (National Archives)

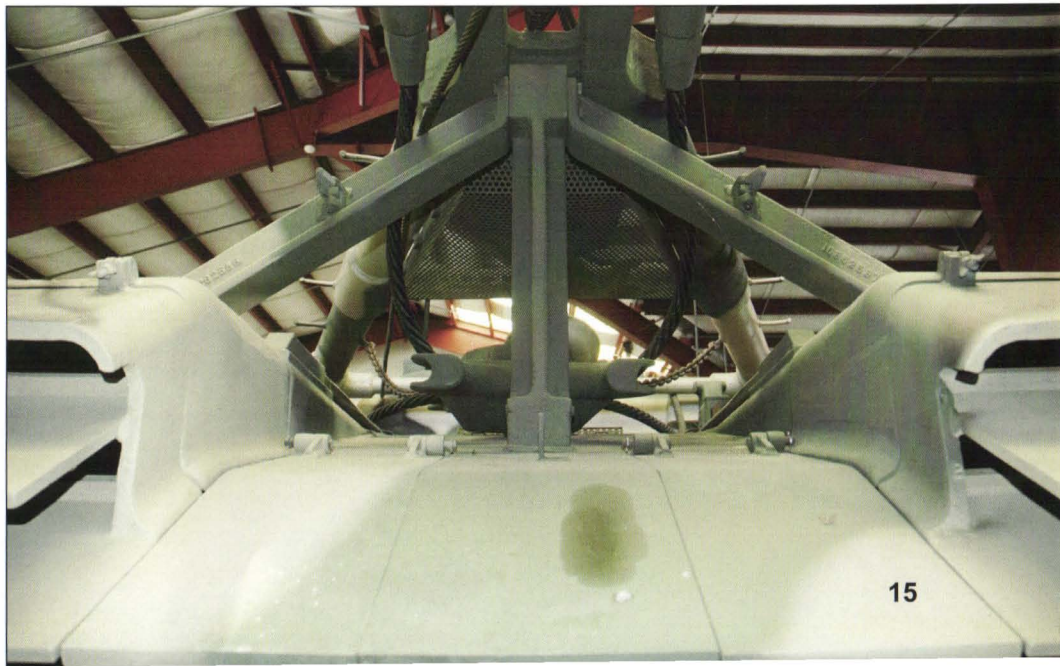
The tow hooks on either side of the lower rear hull of the M88 were rated with a capacity of 500,000 lbs – five times that of those mounted on the front. The pintle hook has a 300,000-lb rating. (Chris Hughes)

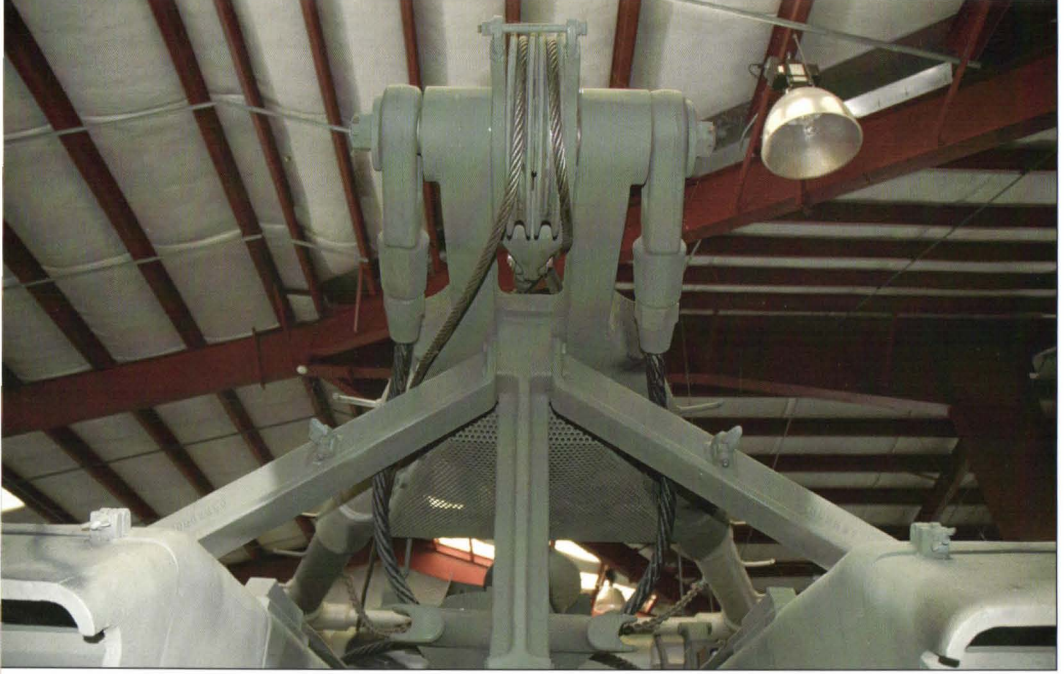
The left blackout taillight/stoplight (left) and rigger's service light, to the right of it, are mounted near the rear of the deck. To the right is the left part of the exhaust shroud, with the hinged exhaust deflector grille door at the aft end. To the left is the rear of the hull, with part of the spare sprocket.

A straight-on view of the left side of the rear deck shows the positioning of the lights. The bar at the far right is one of several braces that support a hinged exhaust deflector, part of which is visible at the lower right. There is a lifting eye forward of the taillight.

Both exhaust deflector grille doors are hinged on the outboard side, and swing open to provide access to the engine exhaust tubes and caps, one of which is inside each shroud. The exhaust deflector is at the bottom of the photo attached to the brace.

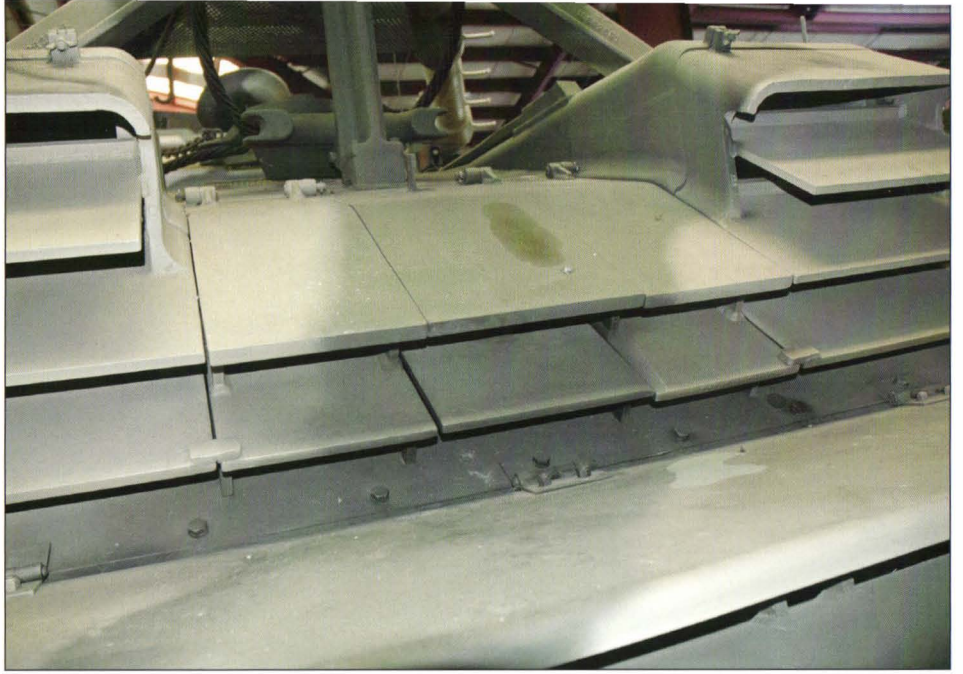
As viewed from the rear of the M88, two center exhaust doors are located in the recess in the rear deck between the exhaust shrouds. There are hinges on the forward ends of the doors, and the boom support is above them. The louvers of the exhaust shrouds, visible at the sides of the photo, are fabricated from relatively heavy-gauge plate.





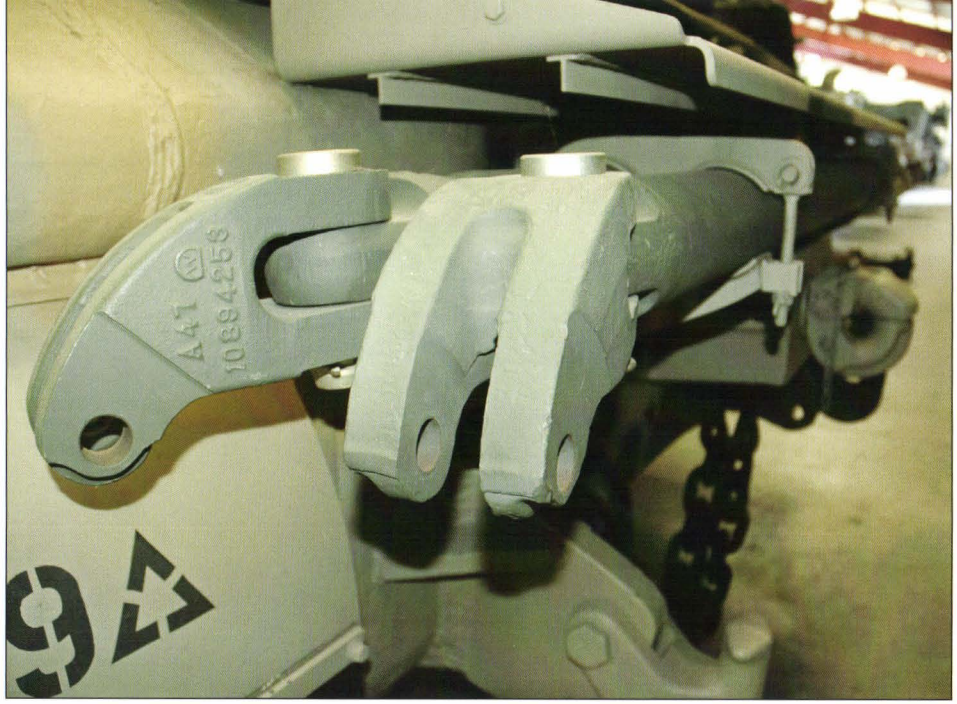
This view of the apex of the boom from the rear of an M88 shows the boom sheave and the attachment points of the two stays on either side of the sheave. The boom rests on the boom support. At either side of the bottom of the photo are the exhaust shrouds.

A view from the right rear corner of an M88 shows the center exhaust doors and the left exhaust shroud and grille. The boom support is visible in the upper right of the photograph.



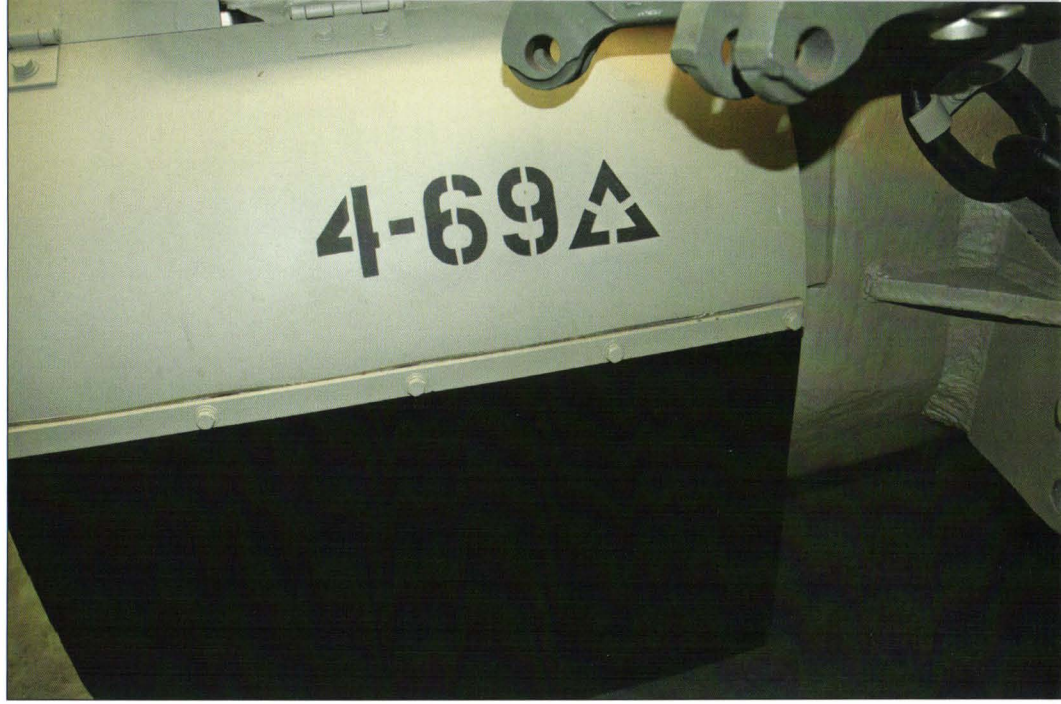
These exhaust grilles (also called louvers) are at the rear of an M88. The hinged, adjustable exhaust deflector is at the bottom of the photo.

The connections at the ends of the tow bar are below the exhaust deflector. Below the tow bar is the towing pintle. Above the tow bar is the left edge of the exhaust deflector and, running diagonally above it, the support bar. On the underside of the exhaust deflector are two T-shaped strengtheners, seen here in profile.



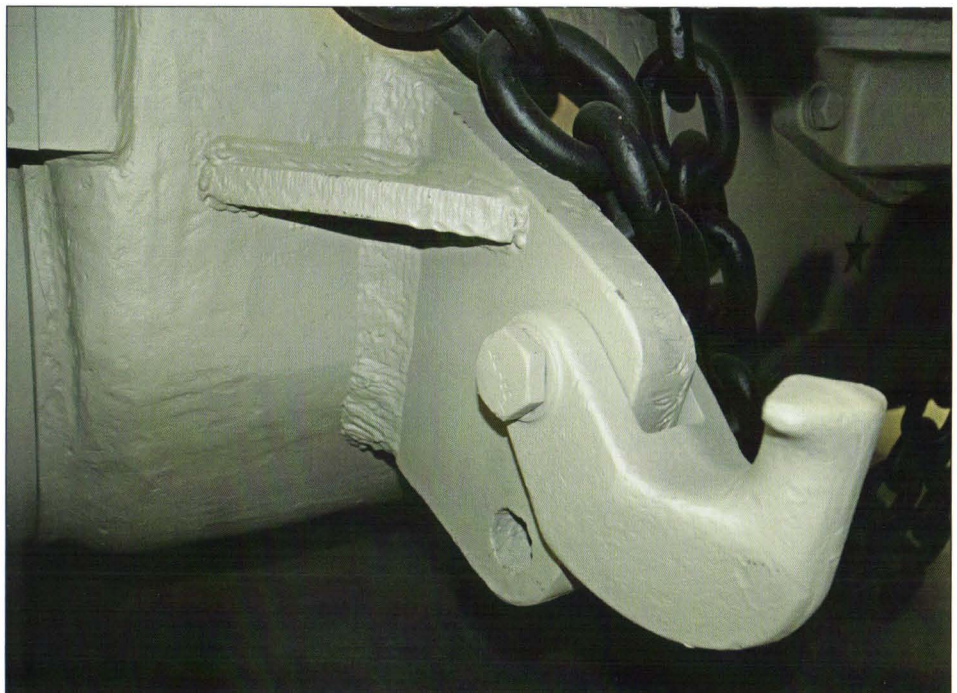
The forks of the tow bar are termed clevises. The lateral stiffeners are on the underside of the exhaust deflector. The left mounting bracket for the bar has a toggling screw and wing nut to secure the upper jaw in place.

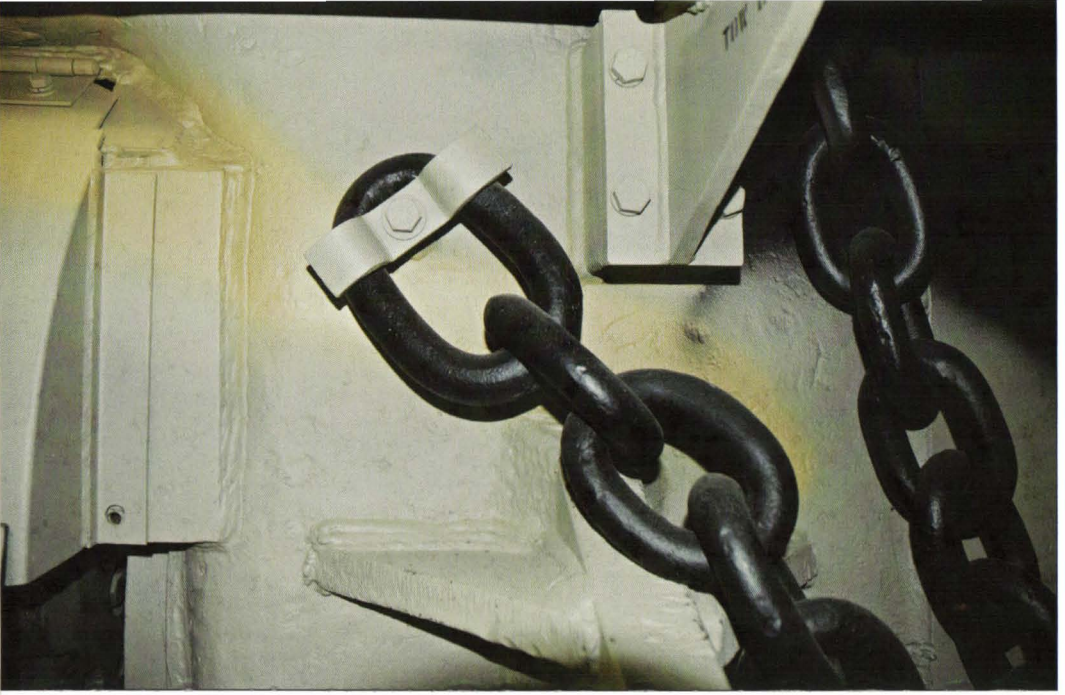
A gusset braces the towing eye on each side of the left rear tow hook. The heavy welded seams are plainly visible.



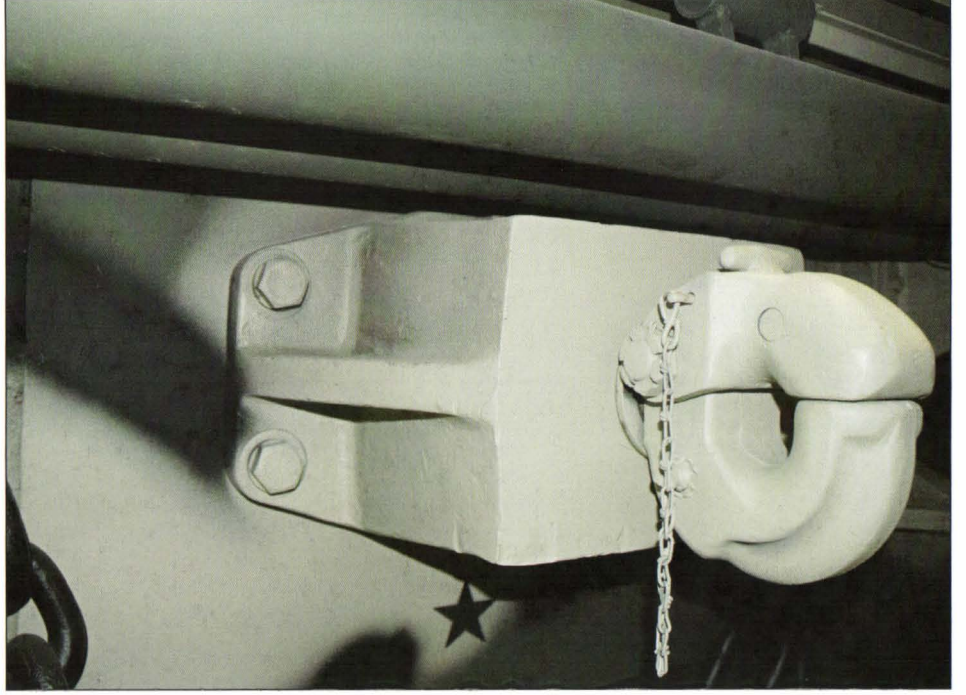
Mud flaps are bolted to the mudguards which, like this left rear guard, are hinged.

The stored tow chain appears in the foreground of this shot of the inboard side of the left rear tow hook. The lip on either side of the outer end of each tow hook helps retain the tow cable in place until tension is put on it. Once pull is exerted on the hook, it rises, and the curve in it keeps the cable secure.



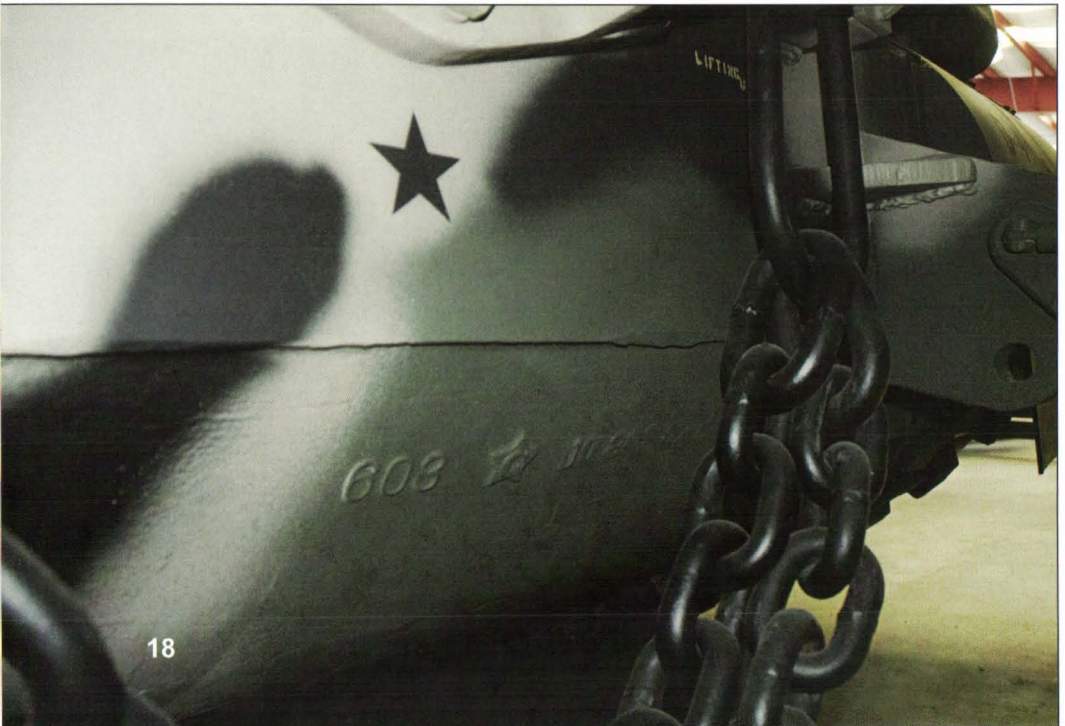


The ends of the tow chain are secured with clamps at the upper left of the rear of the M88. The left tow bar bracket is between the ends of the chain.

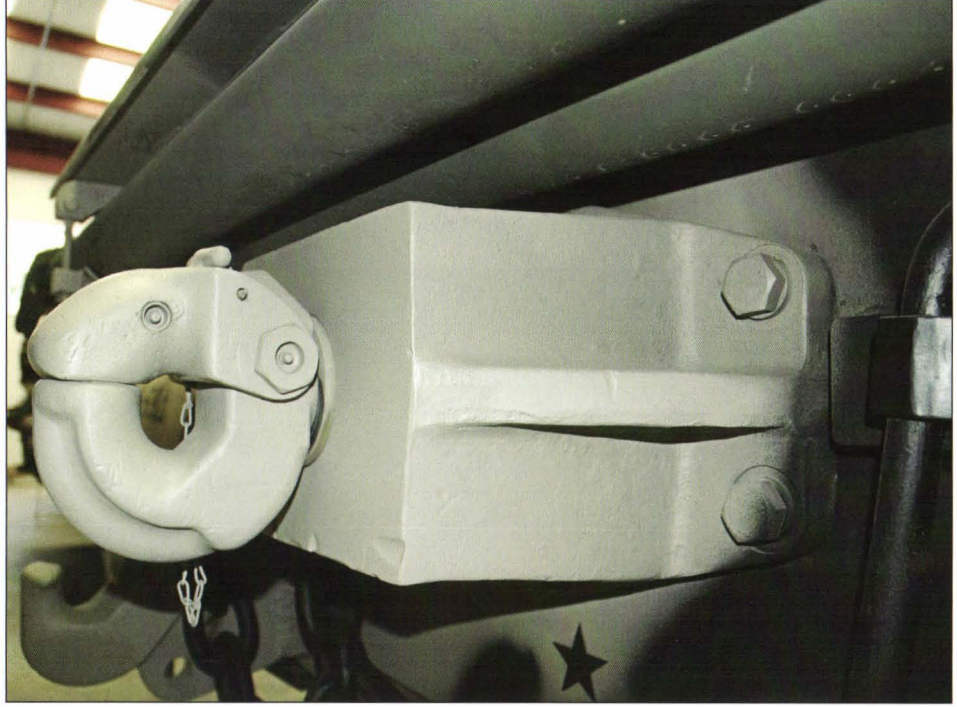


The latch is situated above and pinned to the hook on the towing pintle and mount of an M88. The retainer chain helps keep the latch from getting lost when it is removed.

Casting marks are visible on the lower rear of the hull, below the small national star. The bottom of the pintle mount is at the top center.



The tow bar appears above the M88's towing pintle and mount in this nearly head-on view.

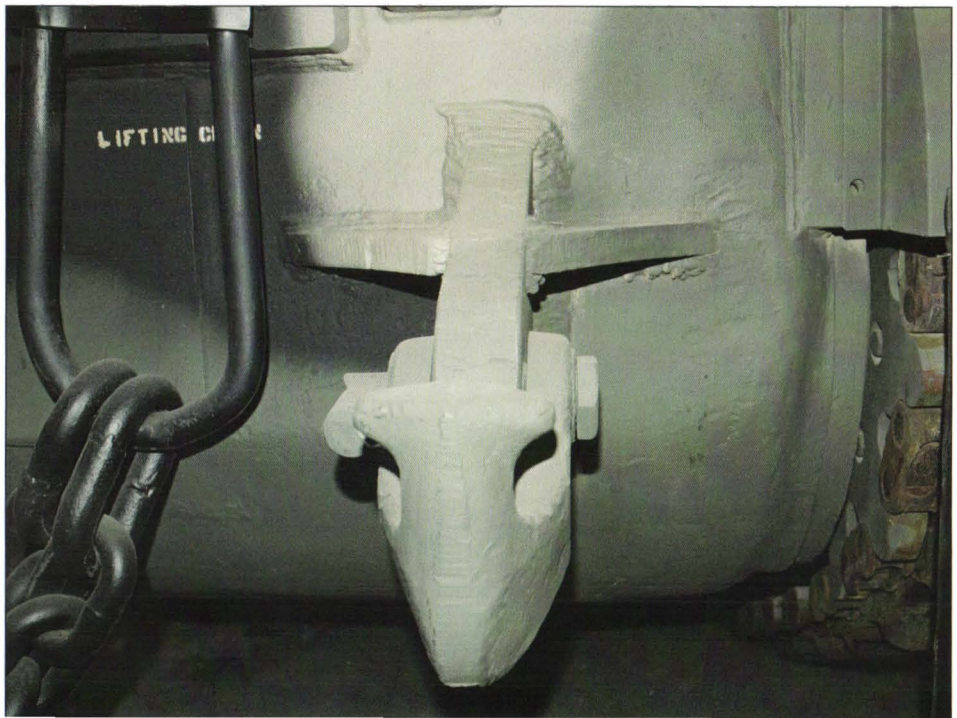


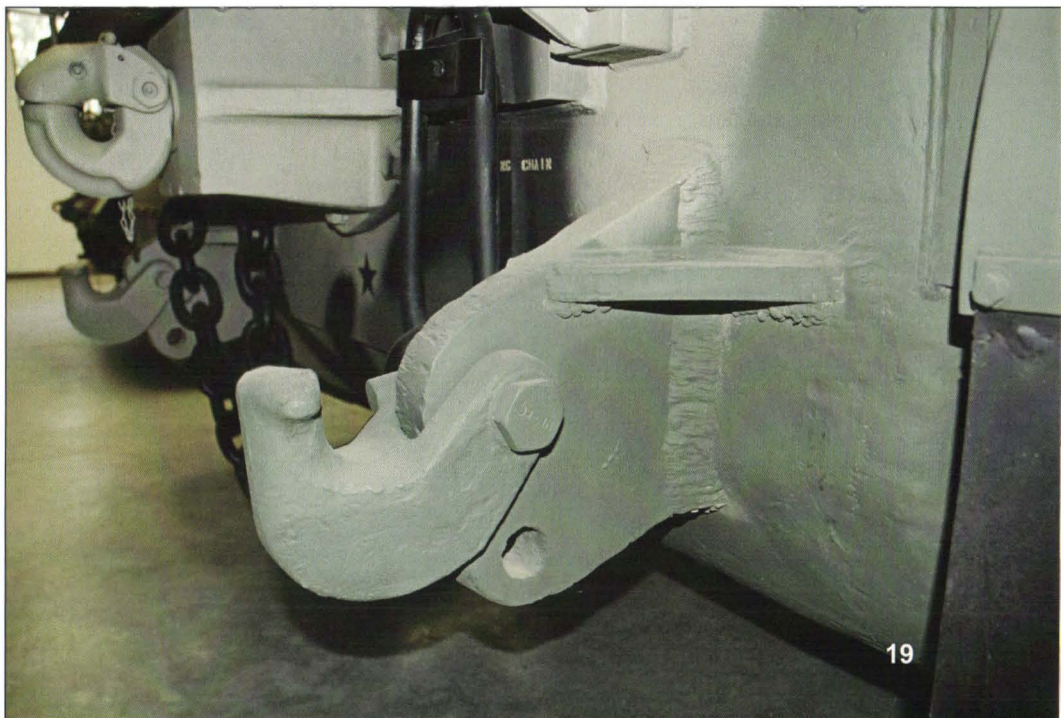
Inside of the mount, shown here from the right, a large, slotted nut secures the pintle to the mount.

To the right of the right rear tow hook, in this straight-on view, are the right mud guard, mud flap, and inner sprocket.

A clamp secures the large towing ring at the center of the tow chain onto the rear of the hull. The pintle mount is to the left of it and the right tow hook to the right. Above the tow hook is the lower part of the right storage bracket for the tow bar.

Both rear tow hooks are visible in this view.



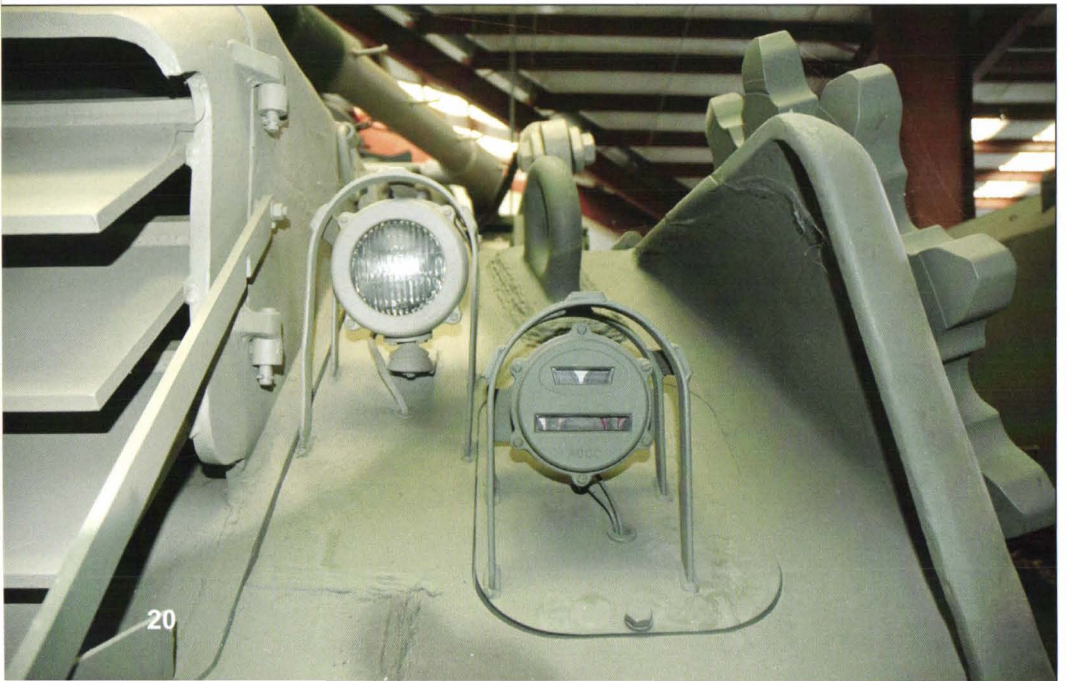


The towing eye and pivot joint of the two sections of the tow bar appear in the foreground. Above them are the engine exhaust deflector, shrouds, and louvers.

The taillights are mounted on plates that, when removed, allow access to the hydraulic cylinders that power the crank arms for the staylines of the boom. The inside of the rear hull plate at the right features a scooped-out design. There are hinges on the outside of the exhaust deflector grille door.

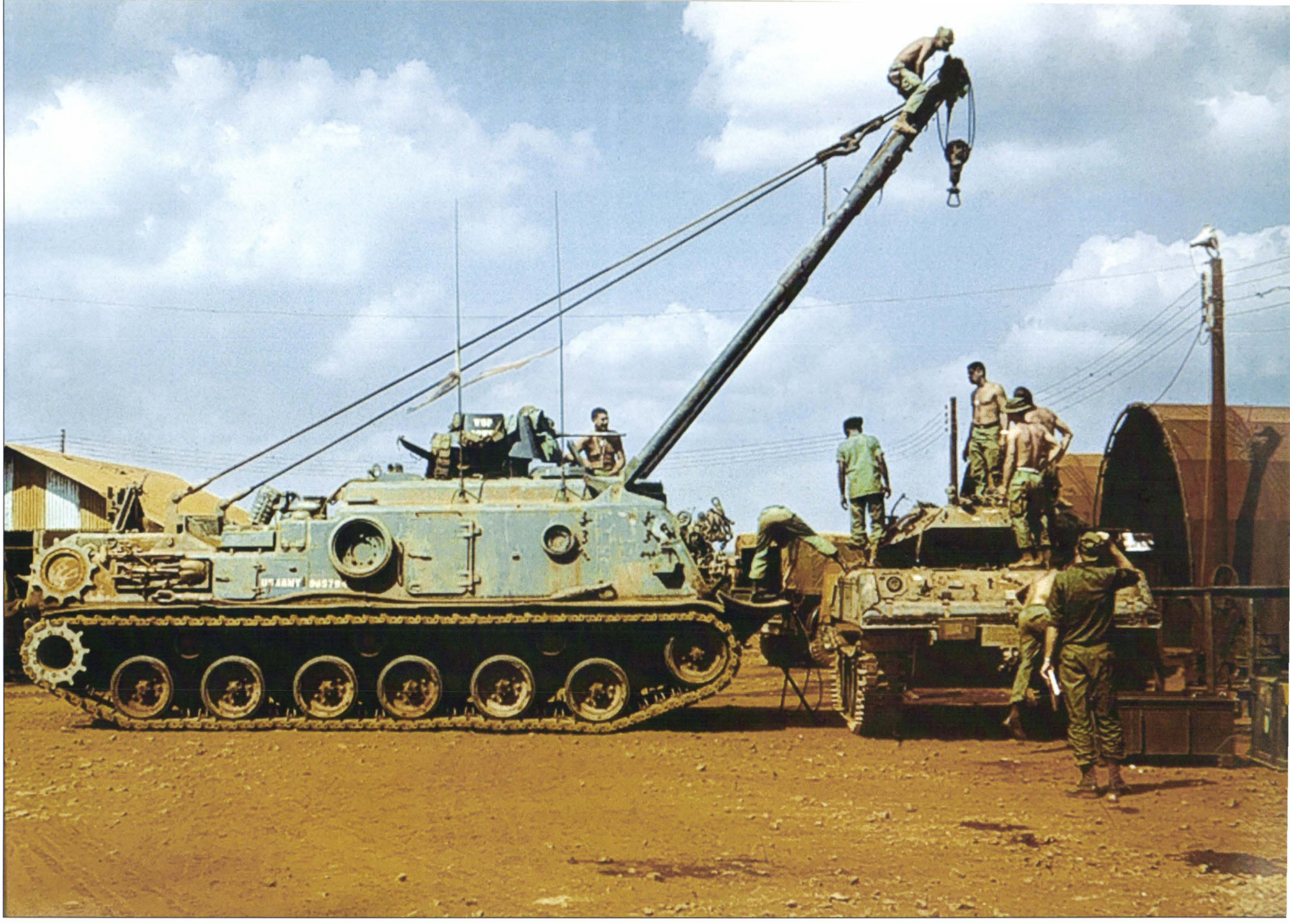
The louvers of the right exhaust shroud are seen from the rear of the M88. To the right is the right rigger's light and its brush guard, above which is visible the top of the right crank arm.

The right side of the right exhaust shroud and grille door shows the brace for the exhaust deflector, with two notches in the bottom for adjusting the angle of the deflector. There is a triangular tie-down on the upper side of the shroud.



The crewmen of an M88 tank recovery use the boom to lift the engine cover of an M60 tank. The hoist cable roller cover between the driver's and mechanic's hatches has been opened. For a light-duty lifting operation like this one, it was unnecessary to deploy the spade. The pioneer tool rack on the vehicle is empty and the sledgehammer normally stored above the rack is missing. This vehicle is painted in the four-color MERDC camouflage scheme. (U.S. Army Engineer History Office)

The tool rack on this M88 contains a full complement of pioneer tools, including an axe, shovel, pick, and pick handle. Above the rack is a sledgehammer, with its head resting in a bracket to the front of the sprocket.



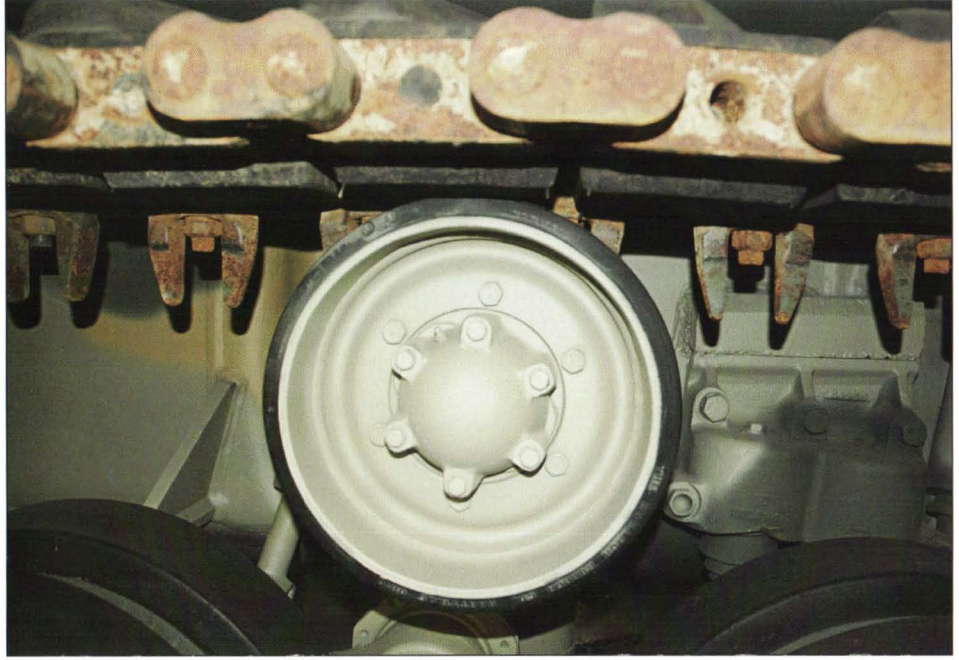
An M88 is being positioned to remove the turret of a Sheridan tank in Vietnam. A rigger has climbed up to the top of the boom to adjust the cables. The spare track links are missing from the front of the upper hull, but the pioneer tools and spare sprocket and wheels are in place, as are the two radio antennas. (The Rock Island Arsenal Museum)

The cutouts are visible in the outer part of the hub of the right sprocket assembly, as are the volute bumper spring and the shock absorber of the rear (or number-six) road wheel.

In this view of the hub of the right drive sprocket of an M88, casting markings are faintly visible below the oval cutout and on the other side of the hub, opposite the channel for the track guides.

The retractable step for the right crew compartment door is extended next to the number-three road wheel. Numerous details of the suspension are evident, such as the rusty surfaces of the track end connectors and guides, as well as the design of the road wheel mount, bump-stop bracket, and the road wheel arm.

This close-up shows the forward end of a road wheel arm where it attaches to the road wheel arm support housing, a bearing which is bolted to the hull. The road wheel arms are fastened to torsion bars, the opposite ends of which are secured to torsion bar anchors on the other side of the interior of the hull.

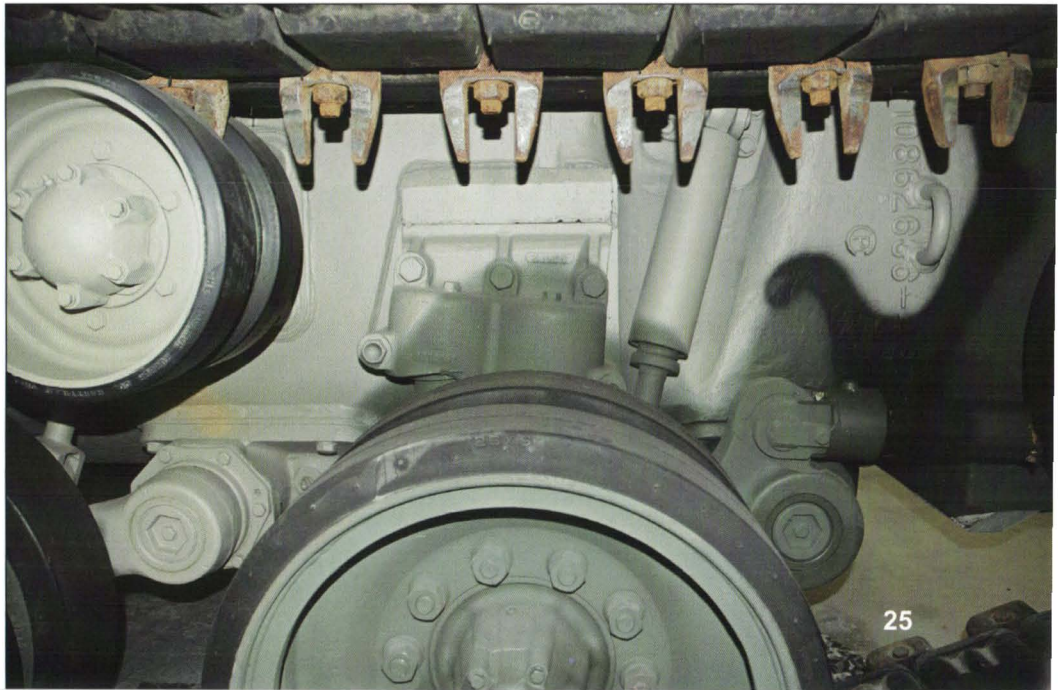


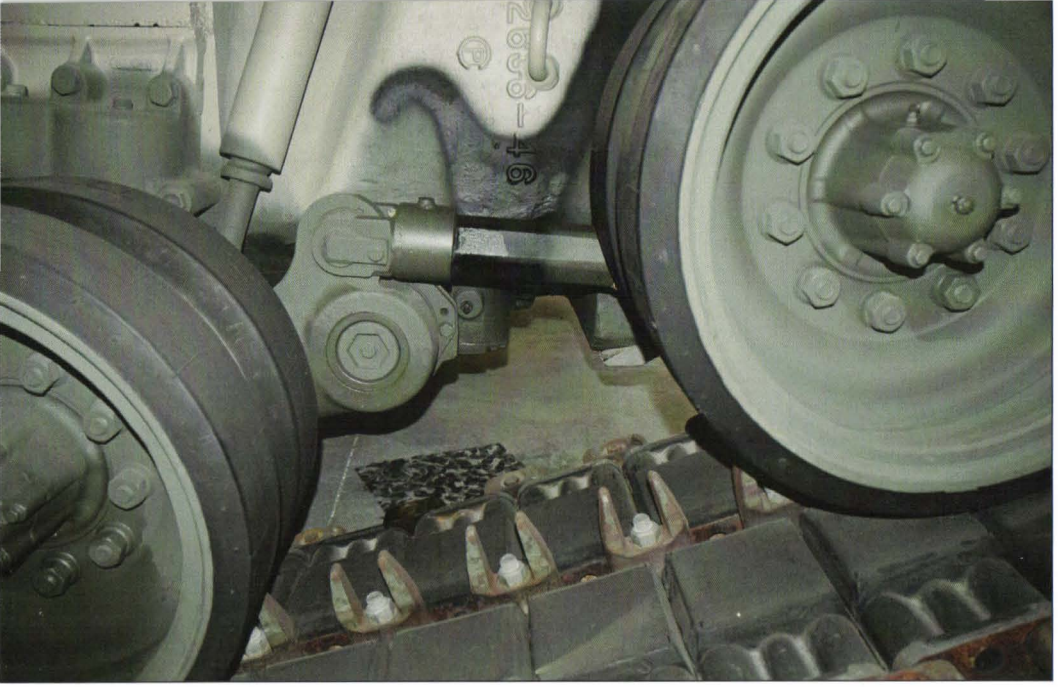
The return rollers are fitted with rubber tires. A grease fitting is visible near the top of the hub. To the right of the right forward return roller is the volute bumper spring assembly for the number-one road wheel arm.

The molding seams at the centers of the tires of the road wheels and return rollers are evident in this view of the running gear of an M88 on the right side facing aft. To the right is a bump-stop bracket.

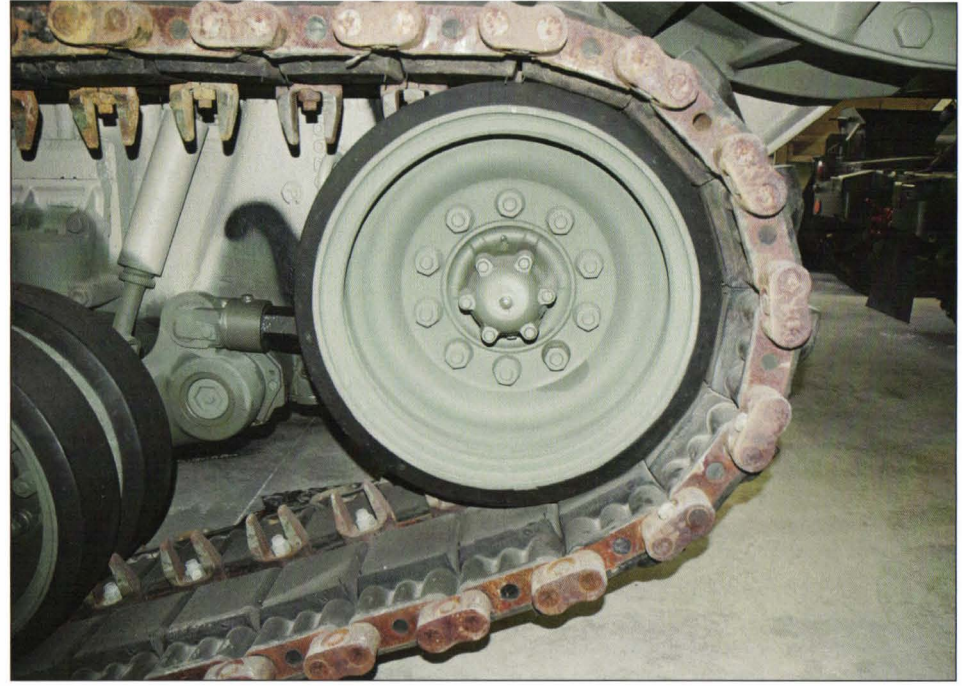
Beneath the number-one (or, front) right road wheel, the end connectors of the tracks are secured to pins running through the track shoes by means of wedging nuts and wedge bolts. The bolt heads are visible on the inner horizontal surfaces of the connectors. To the right is the compensating idler link.

Above the number-one right road wheel are the volute bumper spring assembly and shock absorber and mounting bracket. To the left of the tie-down eye at the upper right is a vertical casting number and mark. At the top are the rubber shoes on the inside of the tracks, and the track guides, which exhibit considerable rust.





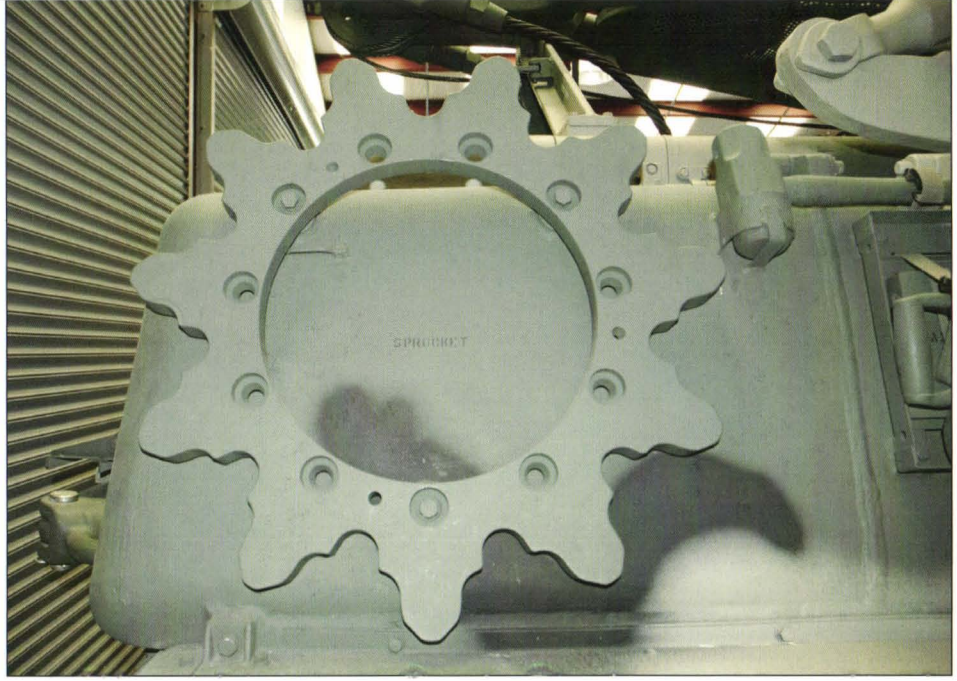
Further details of the compensating idler link are seen here.



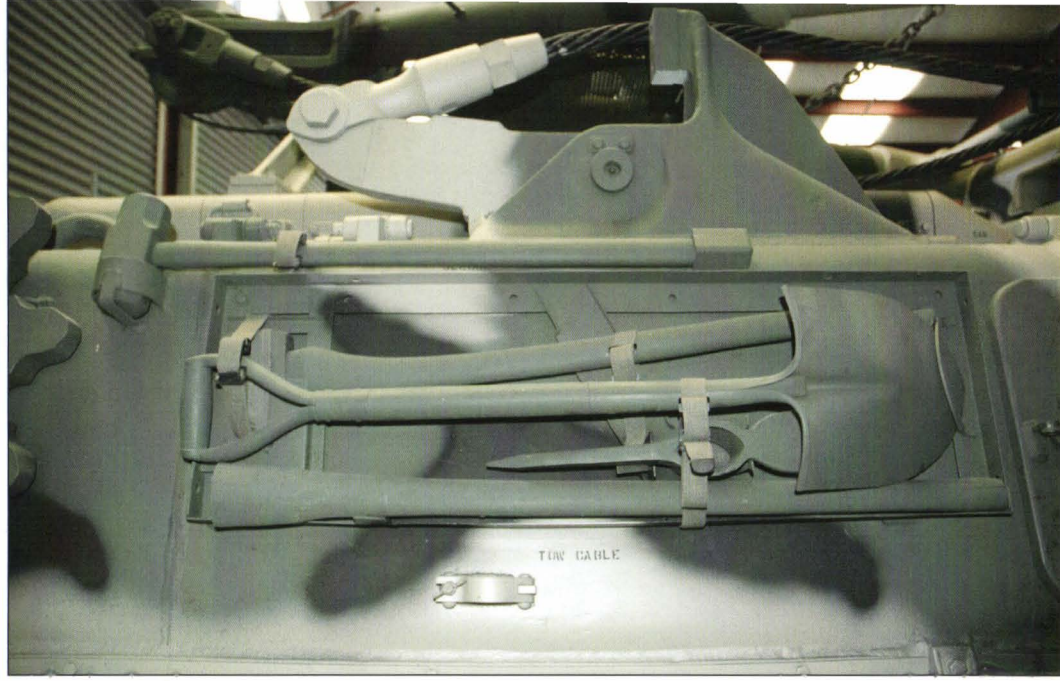
There is a relief valve at the center of the hub cap on the right idler wheel.

A crewman uses some of the M88's onboard repair tools - specifically the oxy-acetylene torch - to break a thrown track on the vehicle. The big retriever will then be pulled from this ditch near Vo Dat, Vietnam, and the track will be reinstalled. (National Archives)

This 1st Battalion, 63rd Armor, First Infantry Division M88 crosses a light tactical bridge during REFORGER (Return of Forces to Germany) II in October 1970. The strain on the bridge is indicative of the M88's great weight. (National Archives)

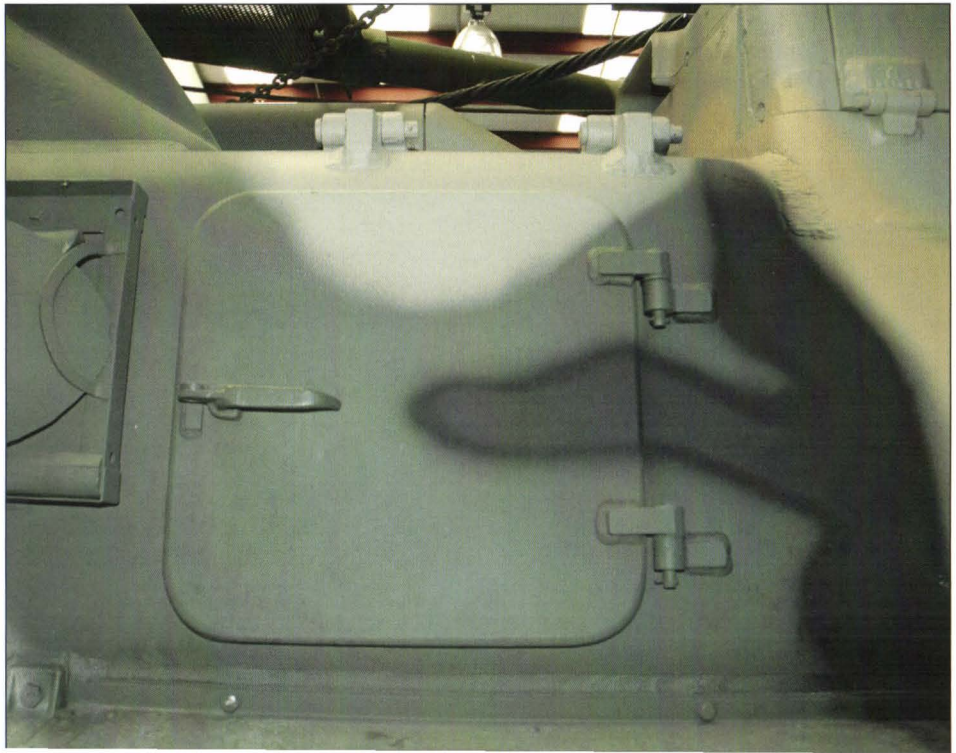


A spare sprocket is stored at the right rear of the hull. To the right of it is a sledgehammer, the head of which fits into a storage bracket.



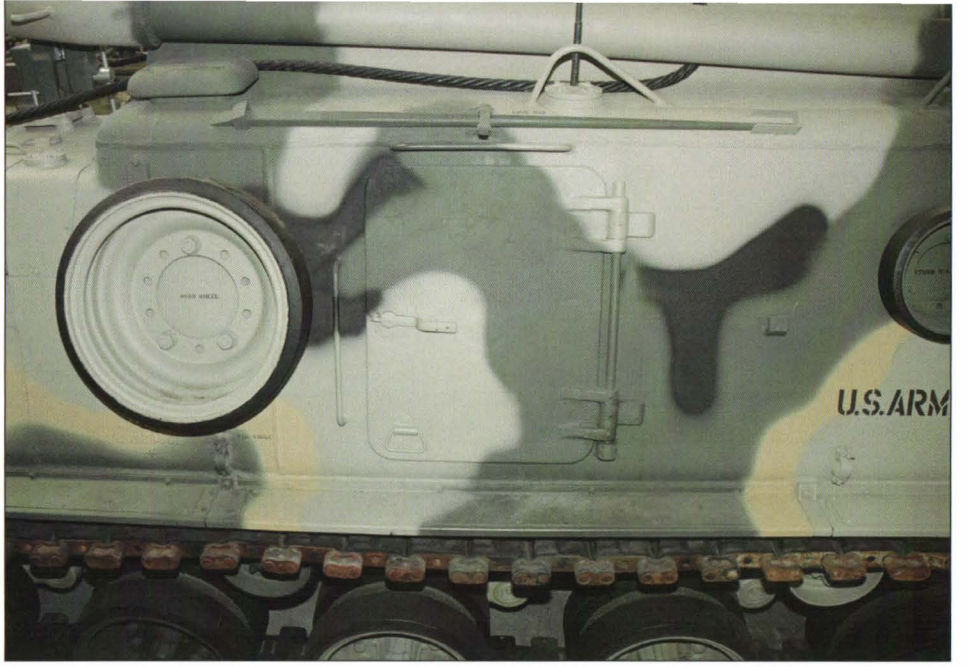
Brackets and webbing straps secure the pioneer tools to the tool rack. Below the rack is a tow cable storage clamp.

Above the door to the small storage compartment on the right rear of the hull are the hinges for the right forward engine air intake door.



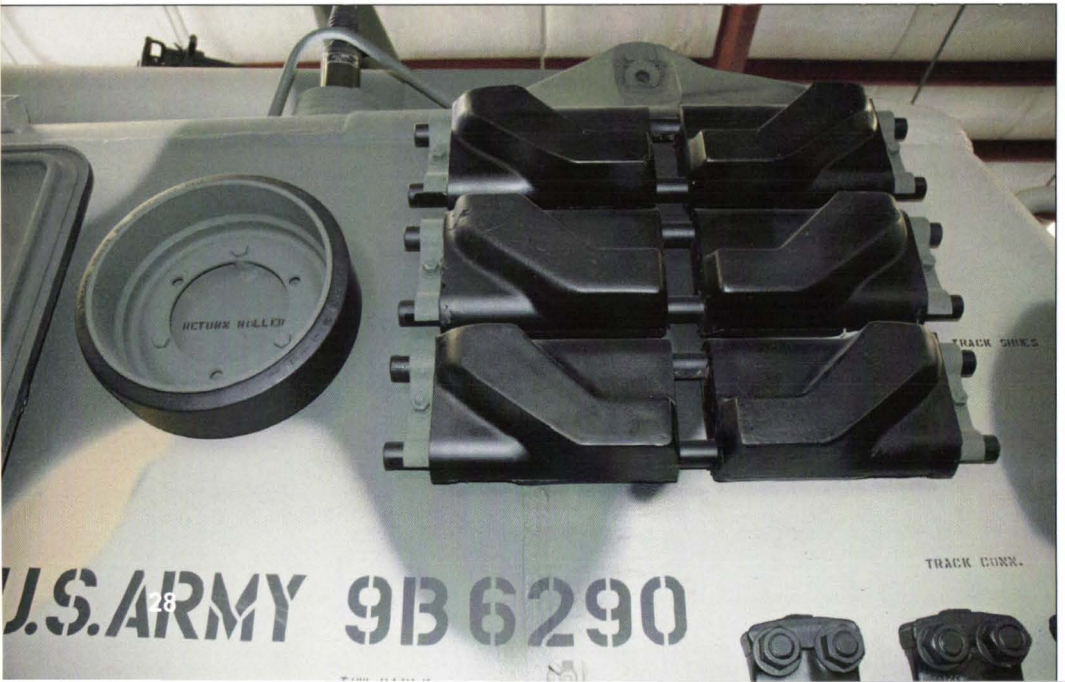
There is a hinged access door on top of the housing for the auxiliary power unit (APU) of the M88. The M88A1 would introduce a louvered door on the side of the housing.

The spare road wheel stored to the rear of the right crew compartment door is secured by hex nuts to three threaded lugs mounted on the hull. Just visible on the roof above the road wheel and below the boom is the right air cleaner inlet cover.

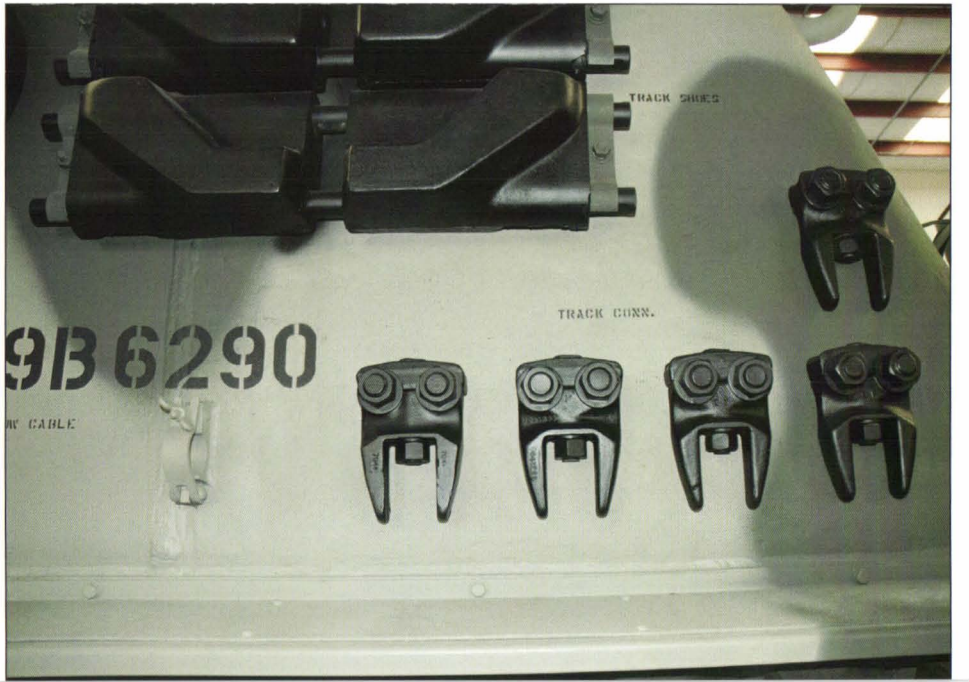


To the right of the right crew compartment door of the M88 is a door bumper. On the roof are the air cleaner inlet cover (left) and the radio antenna mounts (center and right). (Chris Hughes)

A return roller and three spare track shoes are stored on the upper front end of the right side of the hull. Later, on the M88A1, the spare tracks were stored lower, to make room for a smoke grenade box above them. A boom pivot can be seen above the center of the top track link.



Four spare track guides are stored on the lower part of the front right side of the hull. The M88 maintenance manuals specified stencillings identifying where many items of equipment and spare parts were to be stored on the vehicle. Below the 2 in the registration number at left is one of several clamps for securing the tow cable.



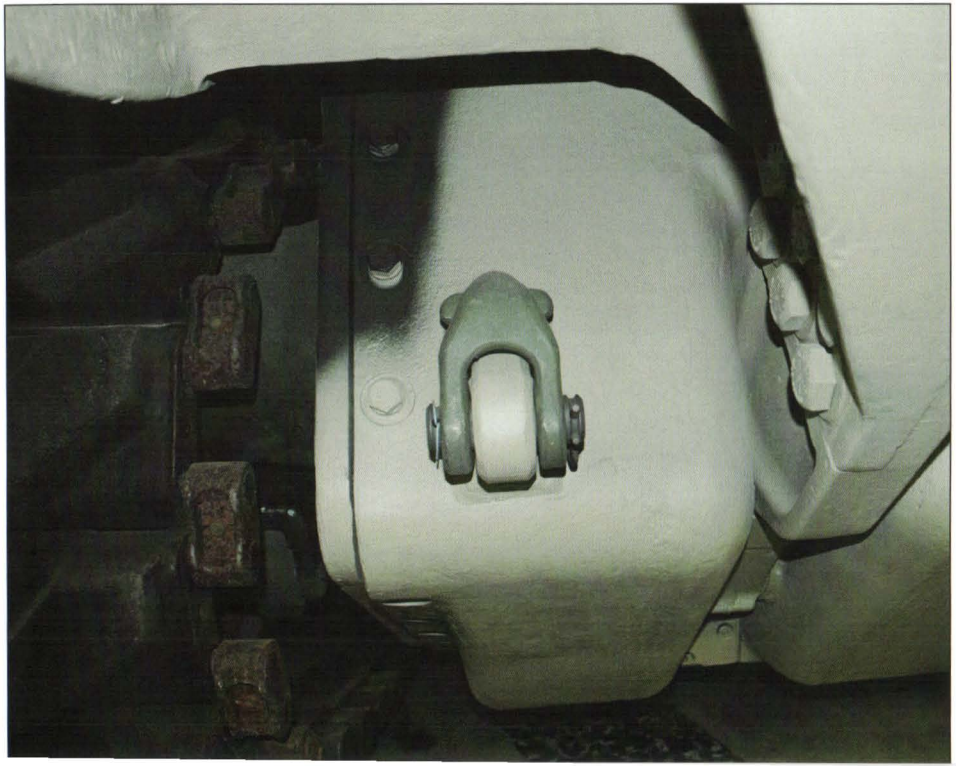
A front-right three-quarters view of "Haulin' Ass," the M88 owned and preserved by the Military Vehicle Technology Foundation, reveals the relatively sleek lines of the hull and the tidy arrangement of the accessories. In the right background is a British Grant tank undergoing restoration.

Dominating the front of the M88 is a retractable spade mounted on two heavy-duty operating arms. At the front of each spade-arm joint is a steel-plate gusset that gives extra strength.

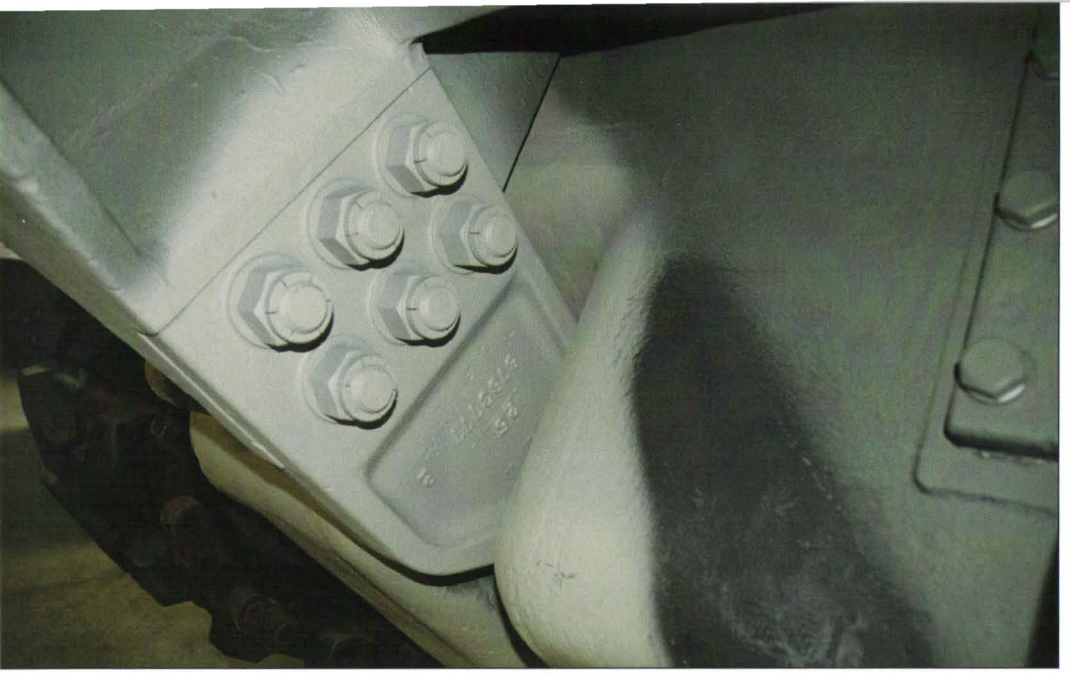
With the spade in its raised position, the curve of the blade is visible in profile. On the glacis above the spade is the front dragline cable roller.

The wedging nuts that secure the end connectors to the track pins are seated in the oblong recesses in the outer face of the end connectors.

This right front tow hook of an M88 has been flipped up. To the upper right is the gusset of the spade arm.



The bow of an M88 is seen from the left, showing the flipped-up tow hook on the towing eye and the right arm of the spade.



This view of the inner side of the right spade arm shows that six hex bolts and locking nuts fasten the lower part of the arm to the upper part of the arm, which is connected to the spade. Casting numbers are on the recess below the nuts.

This shot of the trunnion and lower part of the right arm of the spade shows the pad cast into the arm that makes contact with the plate bolted to the lower part of the recess when the spade is fully deployed.

The towing eye appears in the center of this head-on view of the lower front end of the M88's hull. Flanked by spade arms right and left, the eye lies below a bolted-on plate.

From the front of the M88, this is the view of the underside of the vehicle and the right side of the suspension.

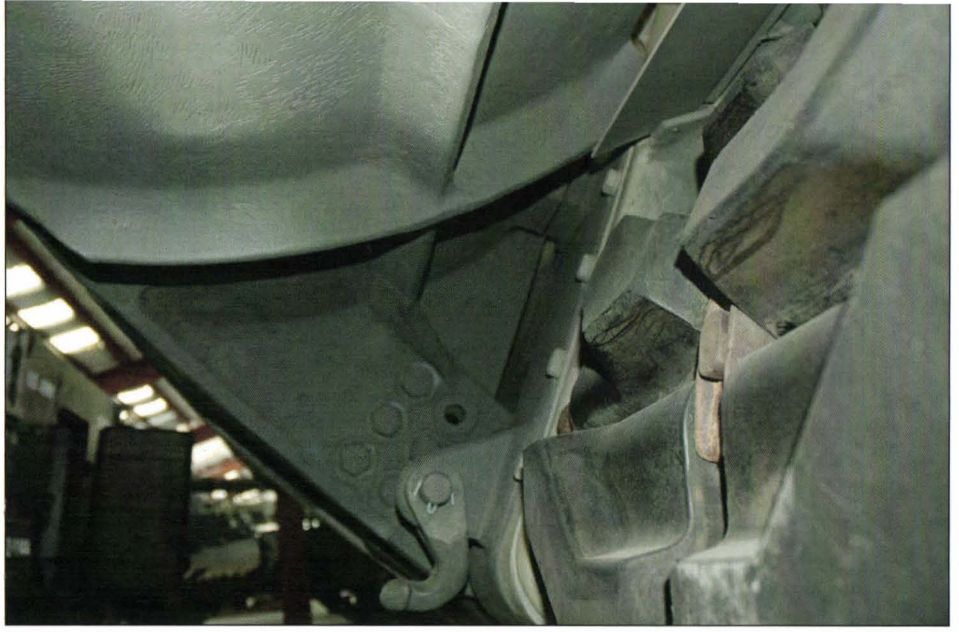
This view of the underside of the M88 from the front shows the insides of the road wheels and the road wheel arms.

The bottom of the left spade arm and the recess in the hull to accommodate are seen at the lower left corner of the front of the hull.

The inside of the compensating idler wheel is to the right in this detail photo of the trunnions of the left spade arm. At the bottom of each recess in the hull for a spade arm is a small, rectangular plate secured with two fasteners.

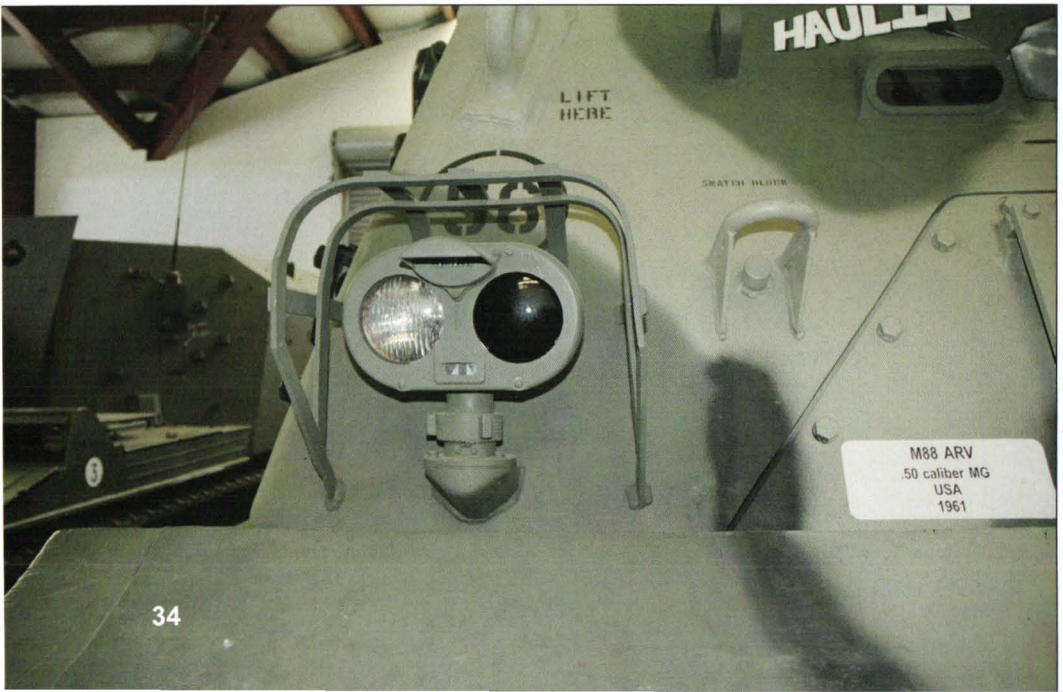
The upper part of the underside of the spade arms are in the form of a gusset, reinforcing the arm's attachment points to the spade. On the outboard side of the left arm are a towing lug and hook.

Tracks specified for the M88 were the T107, a center-guide, double-pin type with 28" wide shoes and a rubber chevron-type tread. There are 84 links, or shoes, per side.

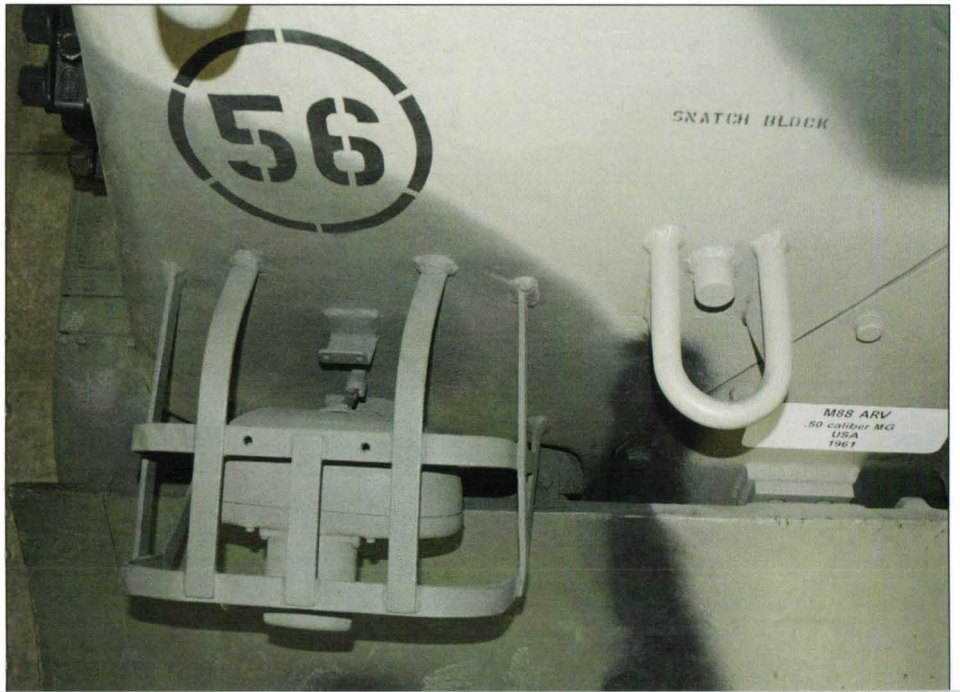


In this view of the underside of the raised spade, the left spade arm is at the lower center of the photo, and the front of the left tracks is to the lower right. The spade was to be used as a steadying and weight-bearing device below the front of the vehicle during lifting operations, and was to be used for only very light scraping duties during site preparation.

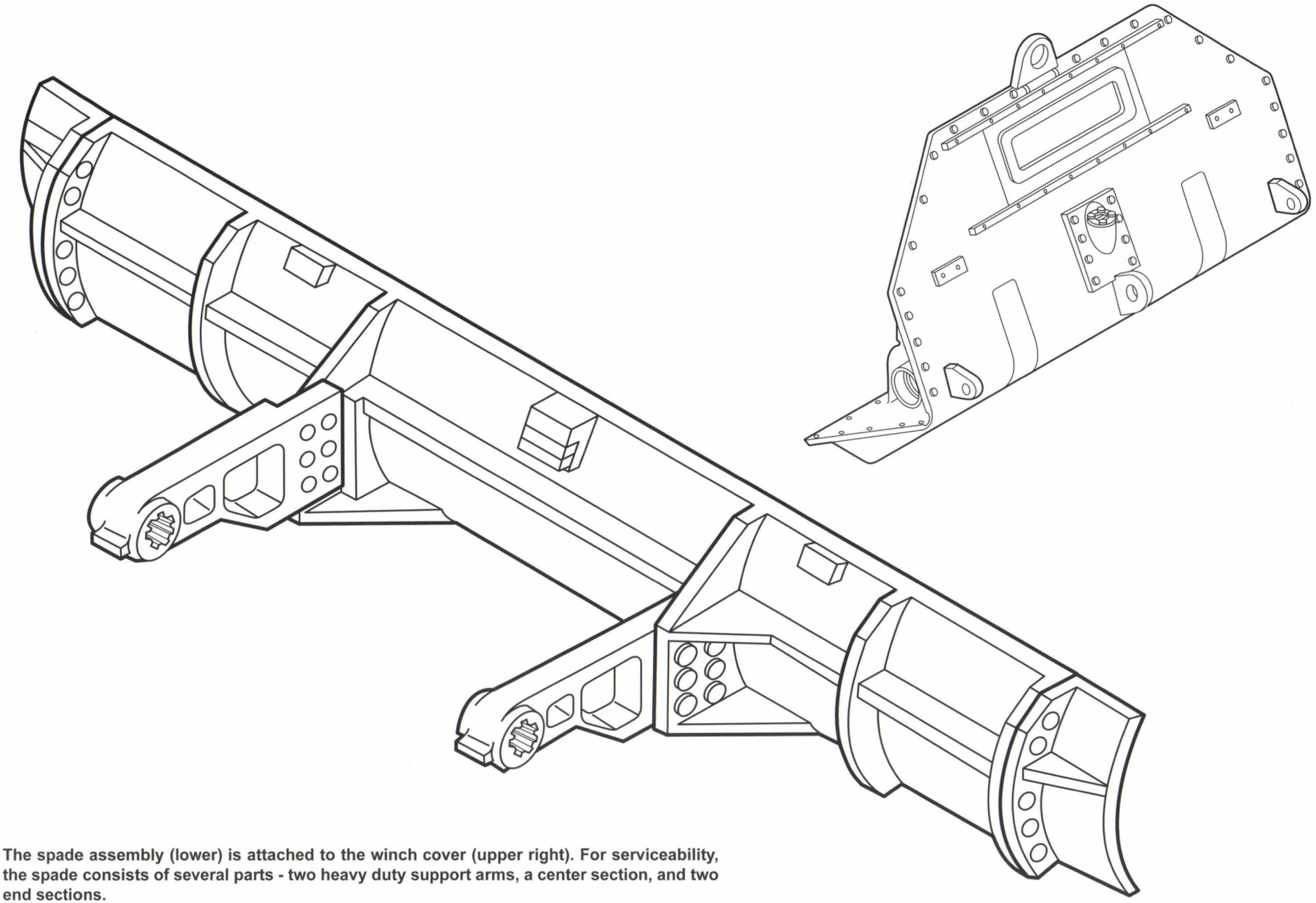
The left headlight assembly and brush guard. Each headlight assembly includes four lighting elements, arranged the same on both the left and right assembly: the service headlight (left in this view), blackout drive lamp (upper center), blackout marker lamp (lower center), and infrared headlight (left). A quick-disconnect nut secures the assembly to the base. To the right of center is a bracket for stowing a snatch block, and at the top right is the mechanic's vision prism.



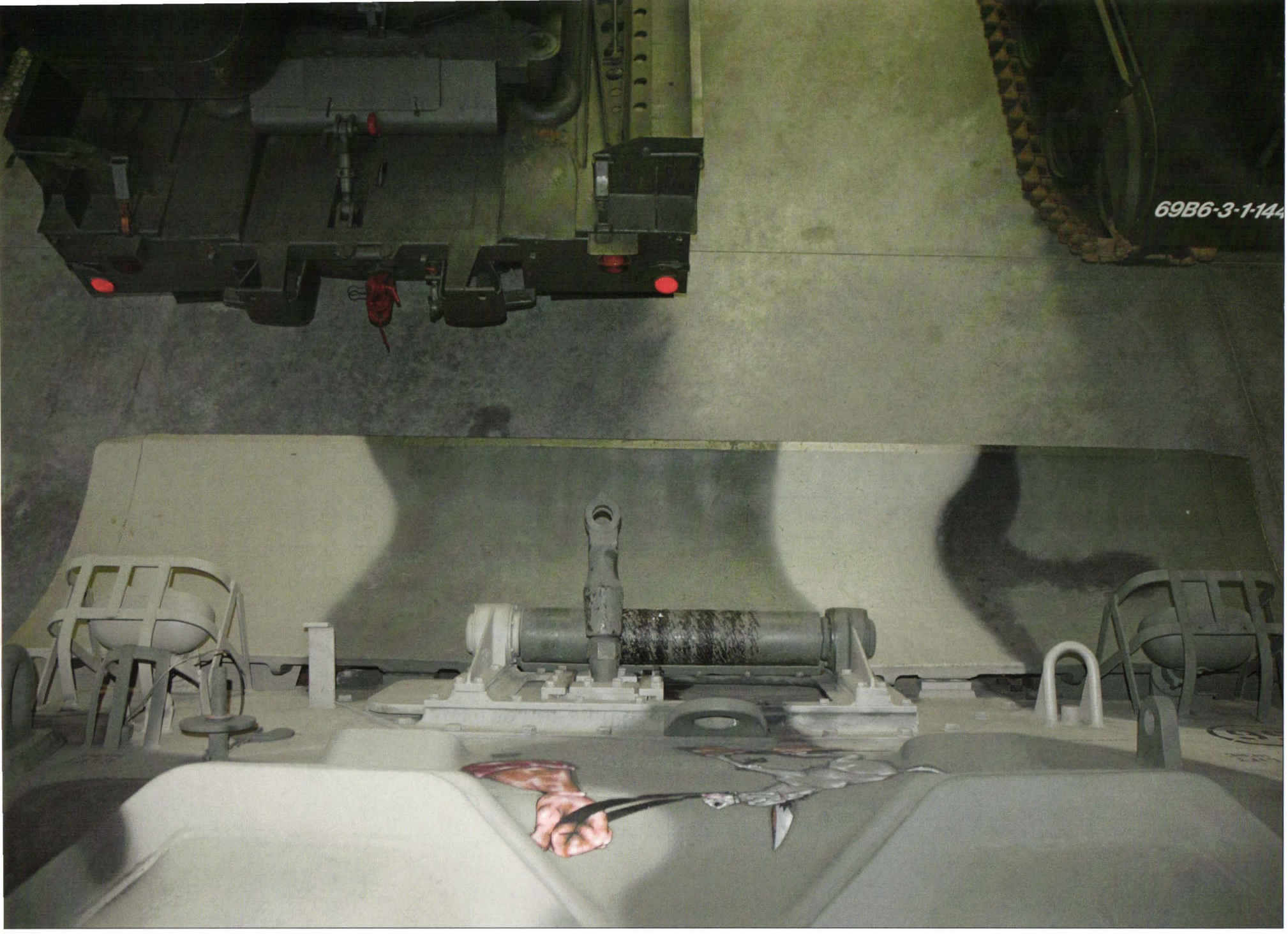
The spade is at the bottom in this overhead view of the left headlight and brush guard, The number 56 in the circle is the bridge classification marking. The U-shaped bracket toward the right secures the lower part of the 90-ton snatch block when stored here.



Spade Assembly



The spade assembly (lower) is attached to the winch cover (upper right). For serviceability, the spade consists of several parts - two heavy duty support arms, a center section, and two end sections.



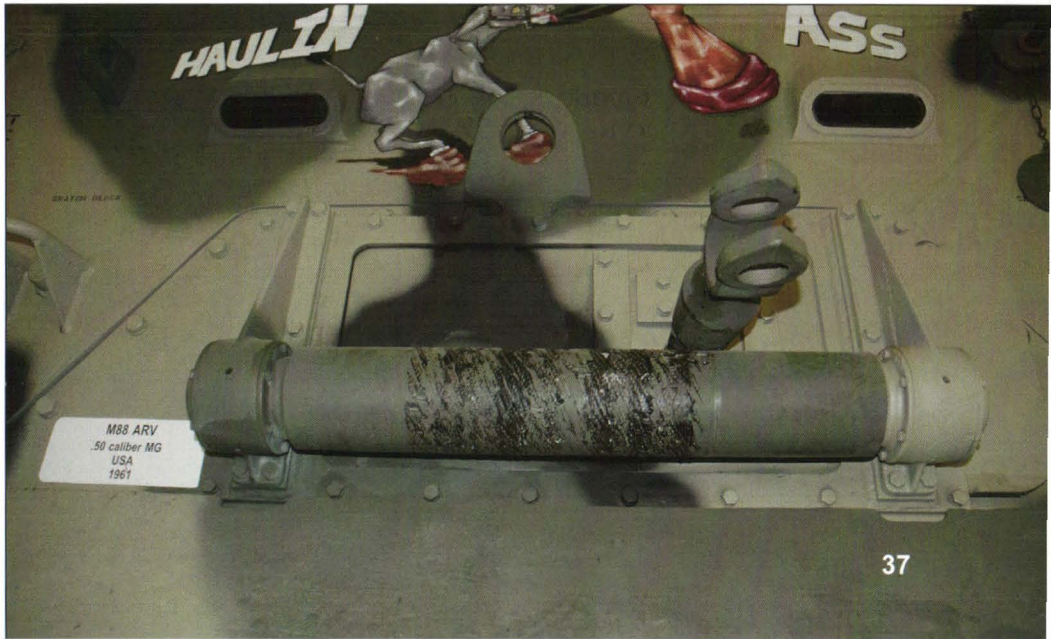
The spade is seen here from above, looking down from the top of the crew compartment. (Chris Hughes)

Above the left headlight is the left lifting eye. The smaller eye to the right of it secures the top of the 90-ton snatch block when stored.

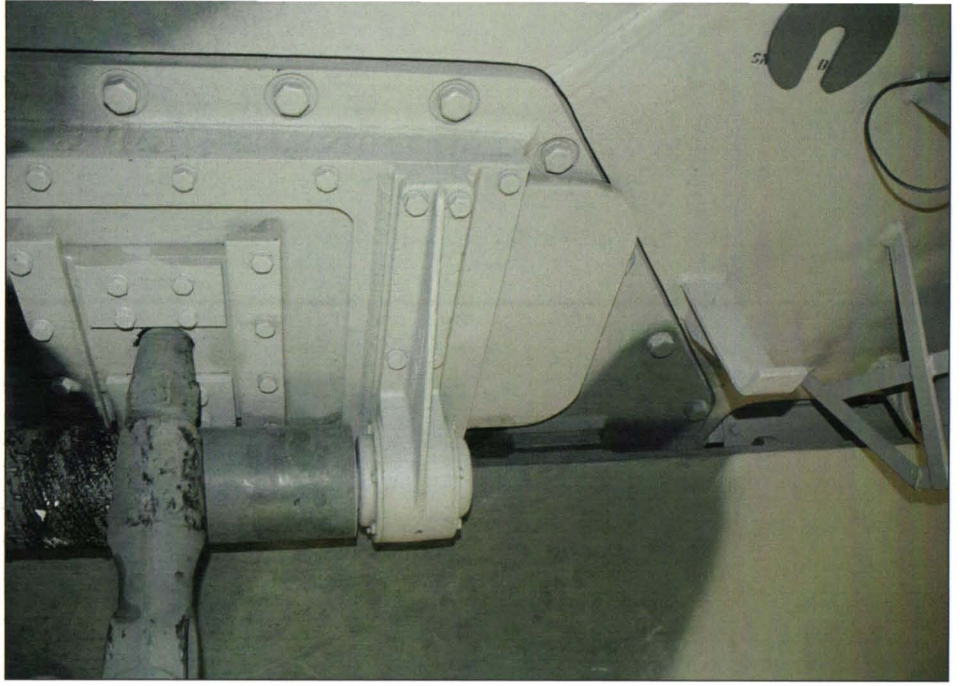
The swell in the glacis that houses the mechanic's vision prism is seen from above. The vision prism is a thick, bulletproof glass block that provided a secure means for the mechanic to view activities to the front of the M88. A similar vision prism and housing are also on the opposite side of the glacis to the front of the driver's position. For front and side vision, the mechanic and driver each also had three vision prisms in their cupolas.

The mechanic's cupola (sometimes referred to as the commander's cupola) is at the top center of the photo, with part of the driver's cupola to the far right. Each cupola has three periscopes. Below the cupola is an oval vision prism; there is one at the corresponding location in front of the driver's position.

Centered on the glacis above the position of the raised spade are the winch cable opening and roller. Attached to the interior side of the winch cover bolted to the glacis are the main winch assembly and the spade actuating cylinders. The lifting eye at the top of the bolt-on plate is used when removing or replacing the winch assembly.

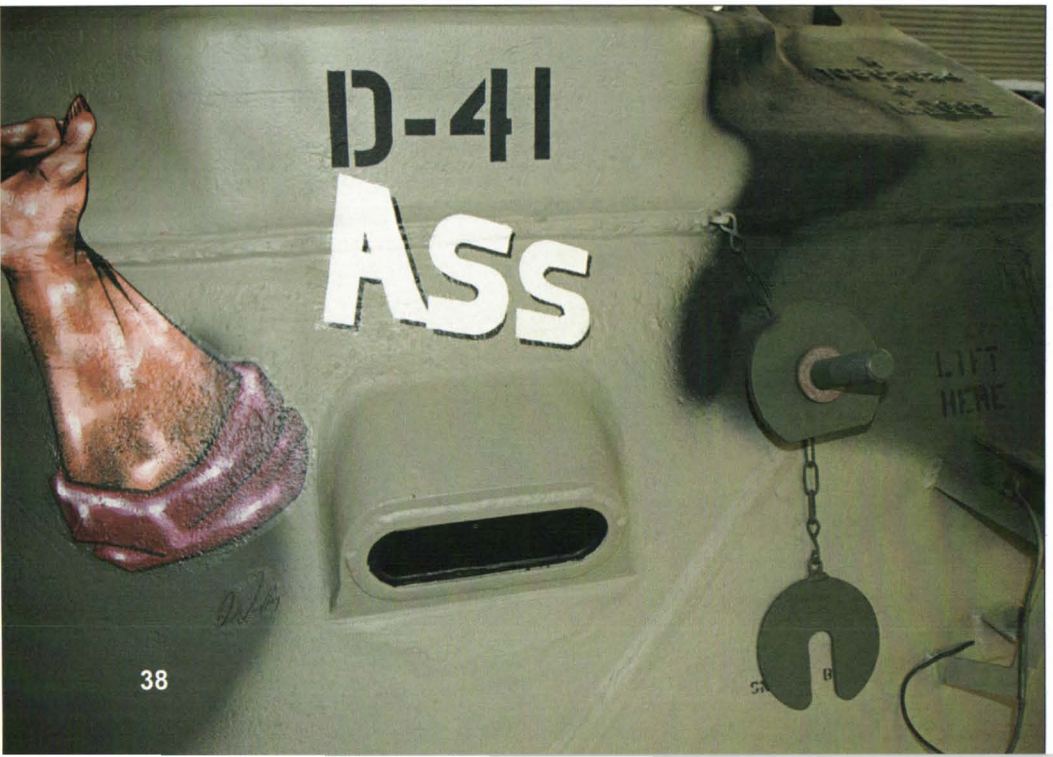


Upside-down casting marks are on the glacis above the winch cover's lifting eye.

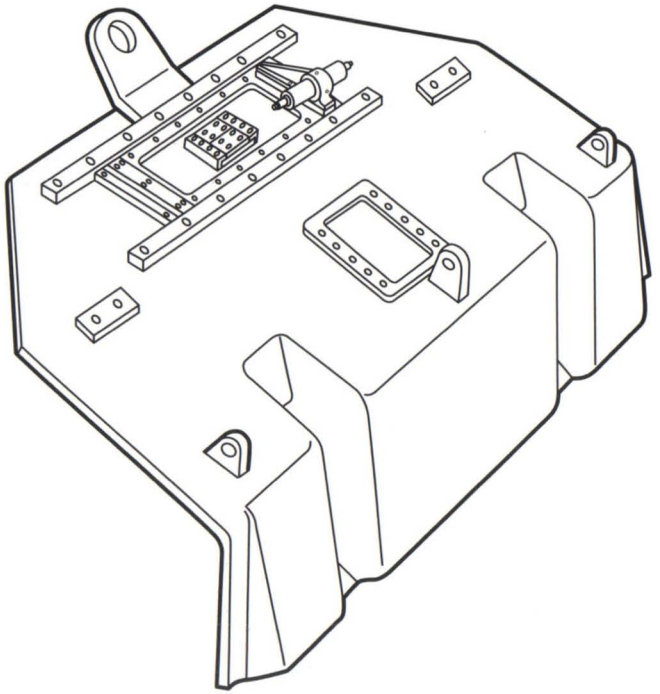


Two half-bushings enclose the cable where it exits the main winch cover. Two retainers (the horizontal rectangular plates with four hex bolts) secure the half-bushings in place, and the vertical guides hold the retainers in place.

The driver's vision prism, with the storage lug for the 25-ton snatch block to the right of it. The C-shaped plate hanging from the chain is the retainer washer, which slips over the end of the lug when the snatch block is in place on it.

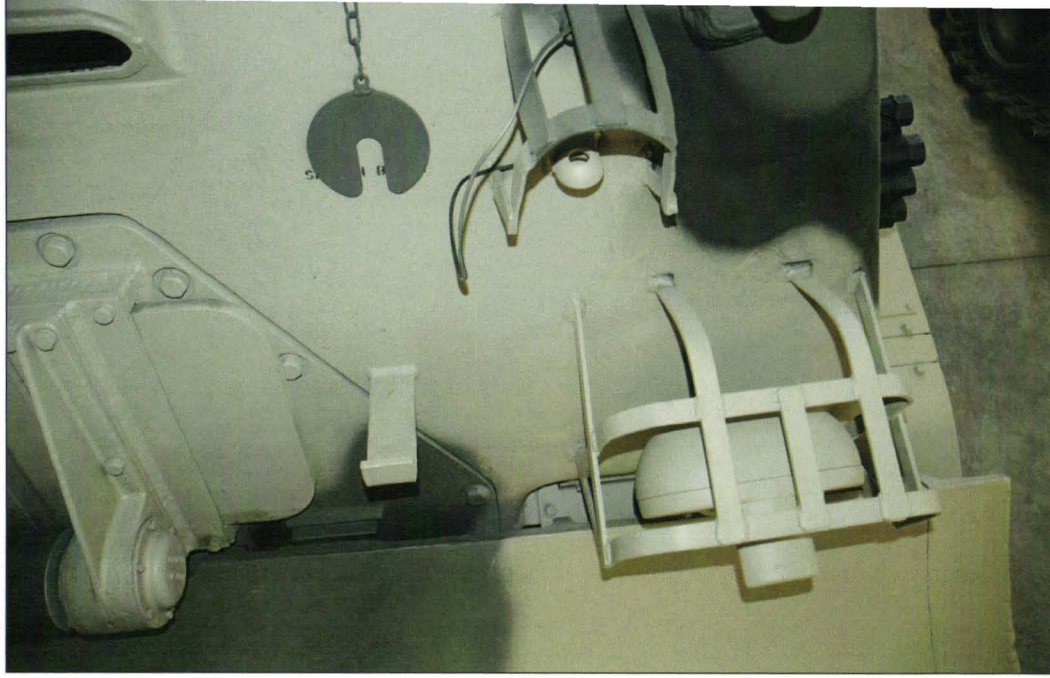


This diagram shows the removable winch cover and winch cable roller assembly.



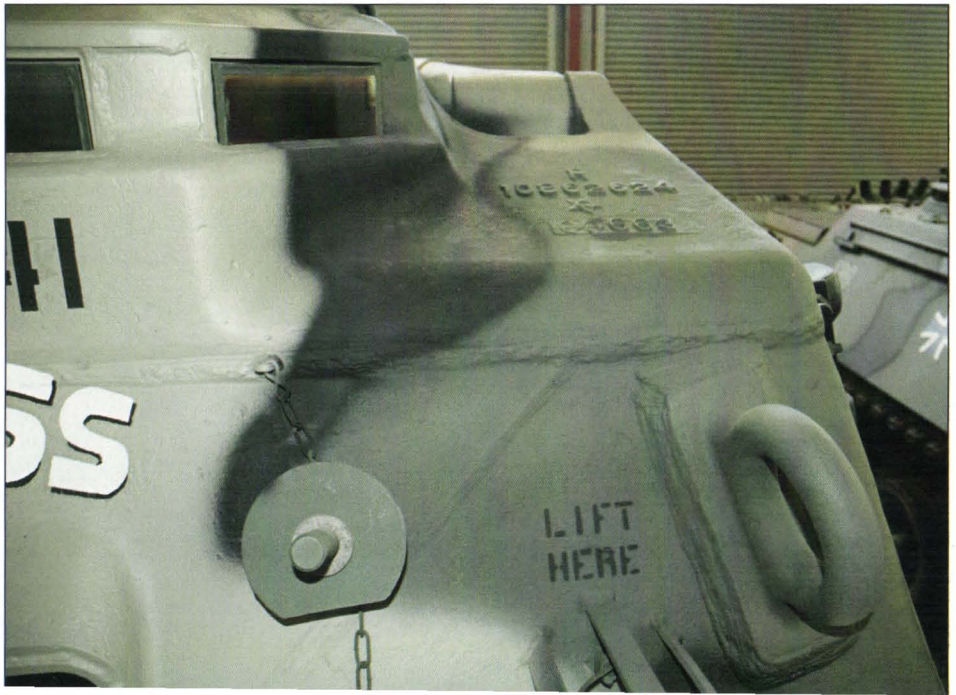
Above the left headlight assembly and brush guard on the glacis is a mount and brush guard for the front flashing signal light, not installed here.

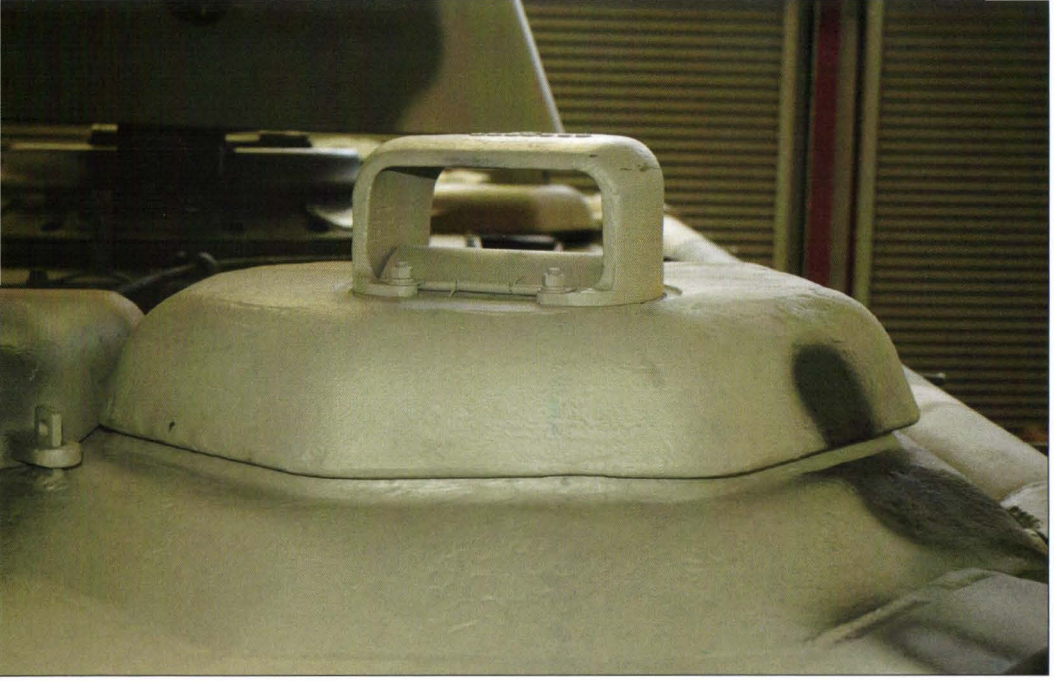
The horizontal weld joint between the glacis and roof is apparent in this photo. At the top of the glacis is a heavy-duty lifting eye and there are casting marks on the roof next to the driver's cupola. On the glacis above the storage lug for the 25-ton snatch block is the attachment point for the chain for the retainer washer seen in the preceding photo.



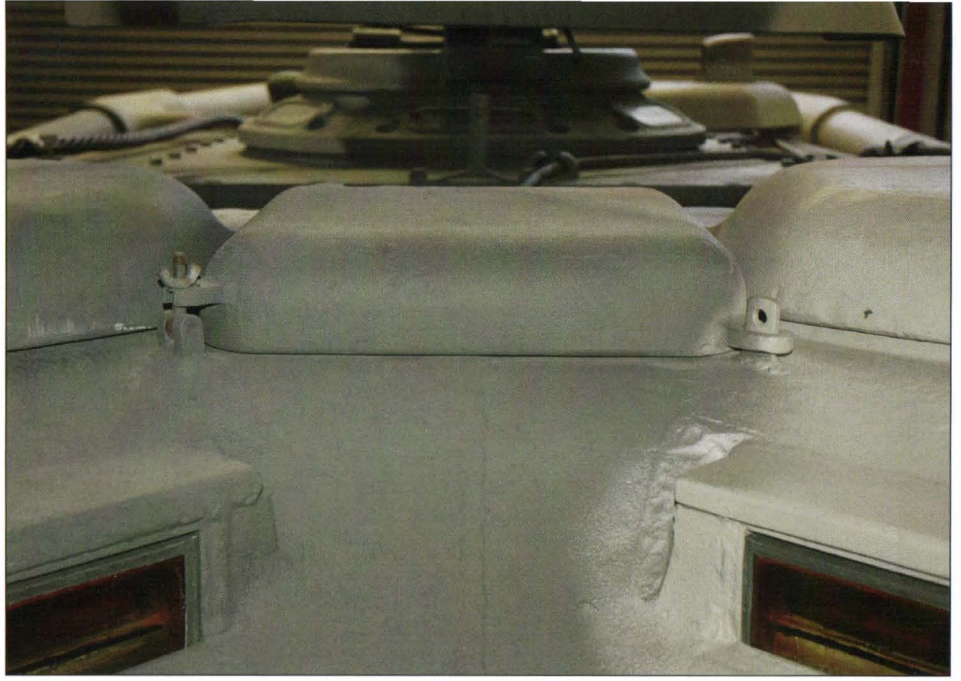
Visible in the lower left of this downward view of the glacis is the left side of the main winch cover. Immediately to the right is the retainer bracket for the lower part of the 25-ton snatch block. The raised spade is at the bottom, with the headlight assembly and signal light mount and their brush guards to the right of center.

The driver's cupola hatch with periscope mount and brush guard, as well as the three periscopes around the face of the cupola, are seen from in front of the vehicle.



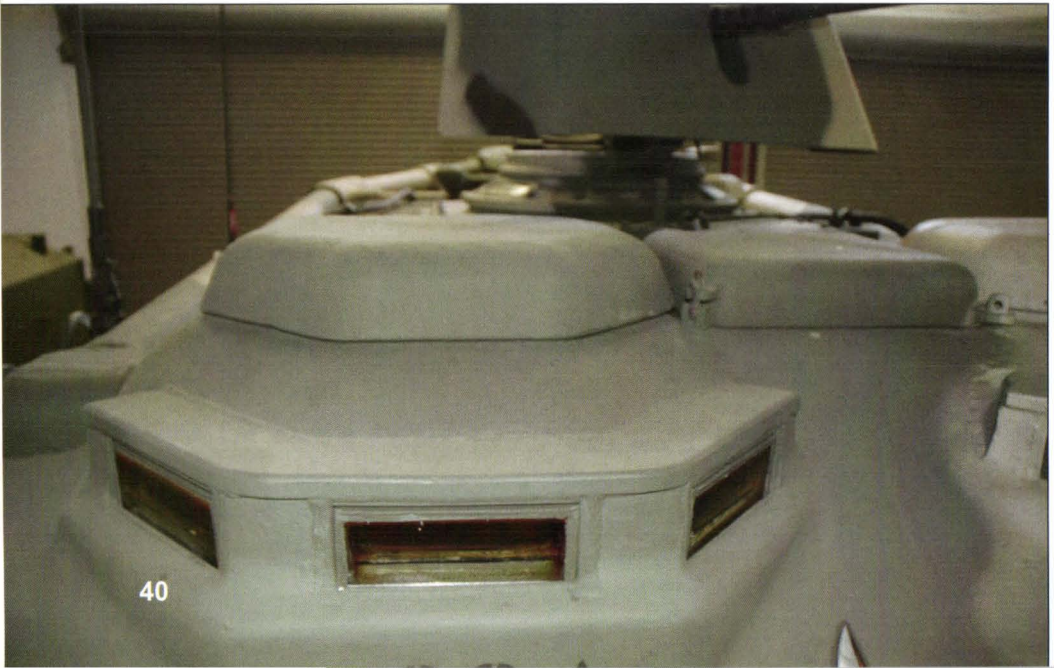


The driver's hatch pivots and swings backward when opened. The sprung cover for the periscope is in the down position here, as the periscope is not installed. The periscope brush guard fits over threaded lugs on the top of the hatch and is secured with hex nuts.

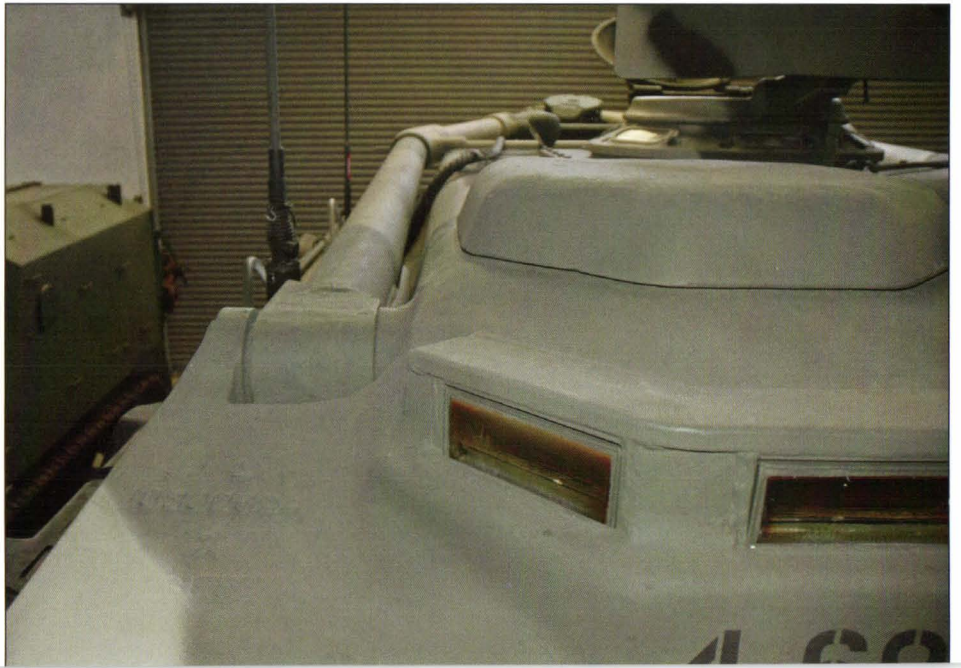


Between the driver's and mechanic's cupolas on the front of the roof is the armored door for the hoisting cable rollers. When the boom is erected, the hoisting cable passes up through an opening in this door to the boom sheave. To the front and rear of the opening are cable rollers.

The mechanic's cupola incorporates a hatch and three vision prisms. The vision prisms provide a protected means of viewing to the front and sides. Unlike the driver's hatch, the mechanic's hatch does not feature a periscope.



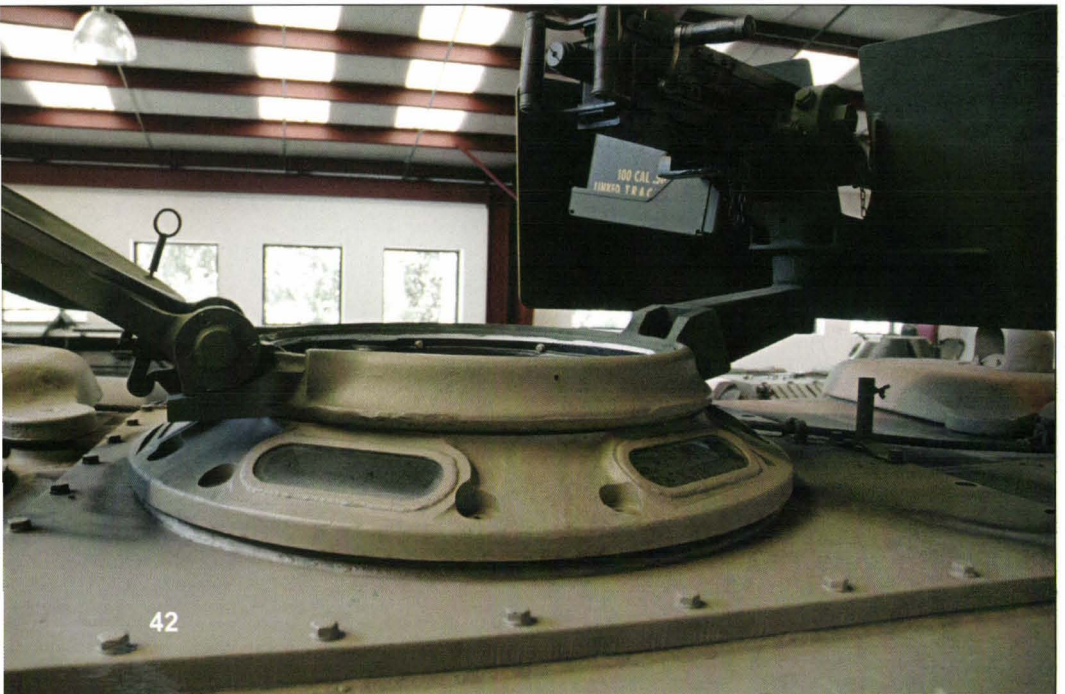
The pivot of the right arm of the boom is incorporated into the roof of the crew compartment. Hydraulic boom-actuating cylinders within the vehicle raise and lower the tubular boom, and steel cables act as stays when the boom is erected.



The crew compartment roof is viewed here from the engine deck looking forward. (Chris Hughes)

Machine gun shields were frequently installed on the commander's machine gun mounts during the Vietnam War. Below the shield is the commander's cupola, and in the foreground are the forward hatches, with the hoisting cable roller door between them.

A view of the commander's cupola and machine gun mount are seen here from the left. The hatch is open, and several of the six vision blocks around the cupola are visible. The cupola is mounted on a plate that is bolted to the roof.

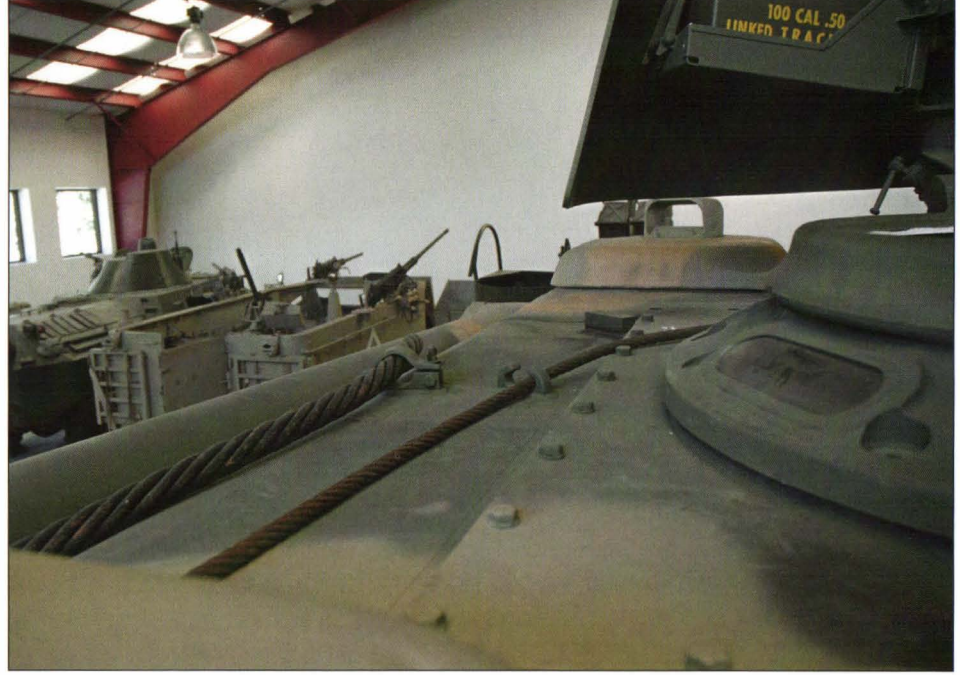


This 11th Armored Cavalry Regiment M88, dubbed "Main Fly" by its crew, rests in its assigned parking space within a motor pool in Vietnam. Typical of vehicles operating in the Central Highlands, the retriever is covered in red clay. The hoist boom is raised, and the hook rigged to the front lifting lugs to secure it. (Patton Museum, Fort Knox, Kentucky)

Details of the commander's cupola, machine gun mount, and shield are seen here. The gun mount is on a ring assembly, allowing it to be swung around 360 degrees. The round indentations on the base of the cupola next to the viewing prisms accommodate screws that secure the cupola to the roof plate.

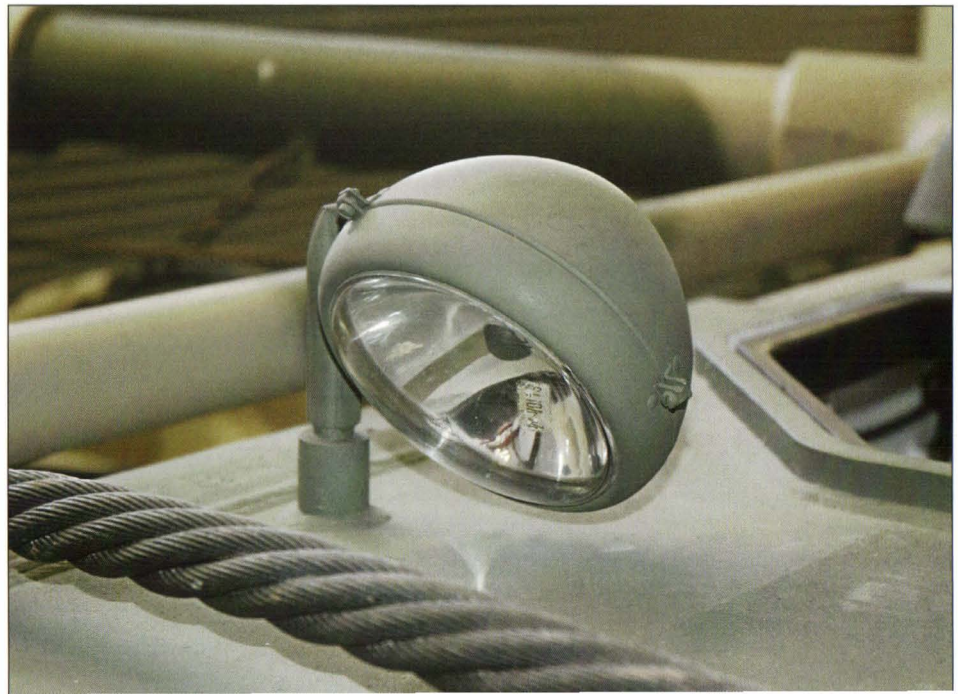
The right boom stayline cable is captured in a cable retainer on the roof. The right boom arm is to the right of the roof.

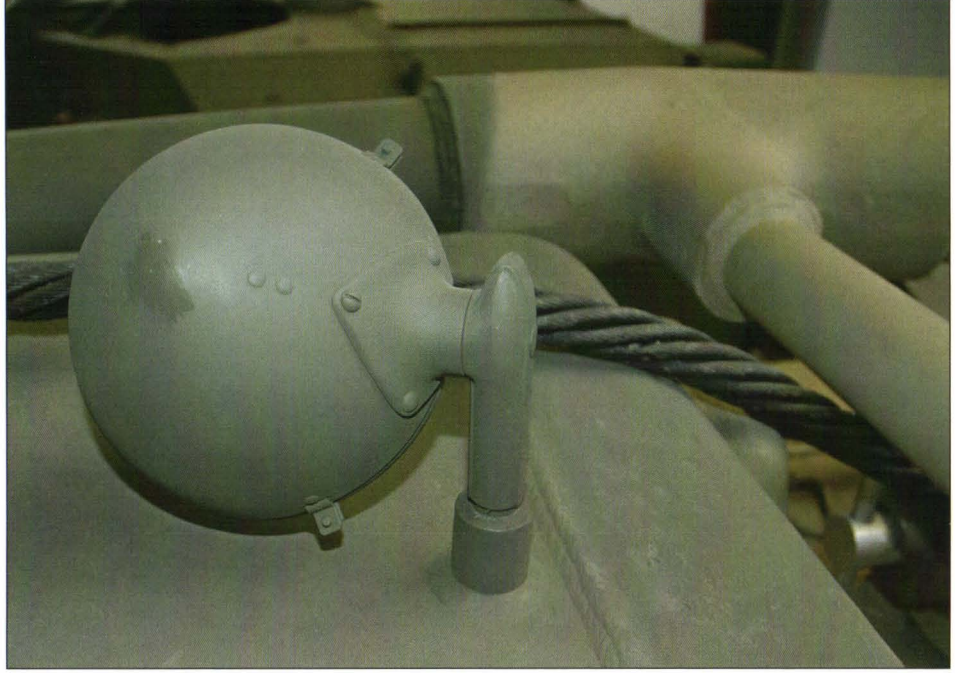
At the center of the rear of the roof over the crew compartment is a hatch for the rigger. It is pivoted open in this view, looking toward the rear of the vehicle. The rigger has a rotating periscope mount with a protective cover on top of the hatch. The left boom arm is visible to the right and in the background.



In this view of the roof of the M88 from the left rear of the commander's cupola facing forward, the thicker cable is the left boom stayline, while the thinner cable is the hoisting cable. When the boom is raised, the hoisting cable is routed from the front of the crew compartment up to and over the boom sheave.

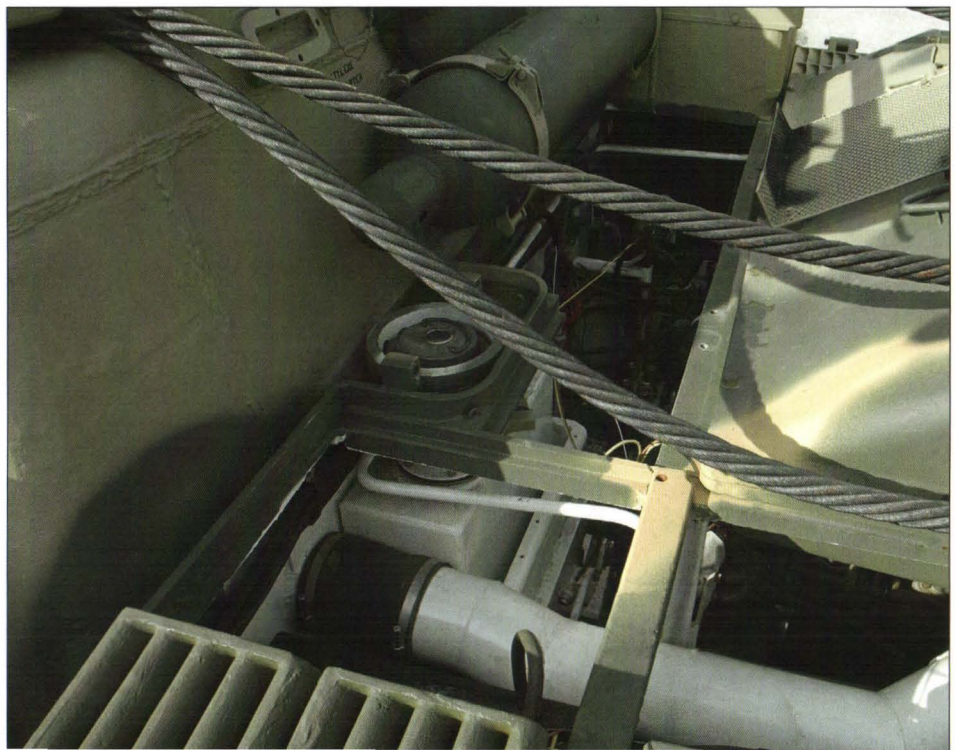
The rigger's spotlight, operable from inside the vehicle, is on the roof to the right of the rigger's hatch. The lower crossmember of the boom is parallel to the rear of the roof.



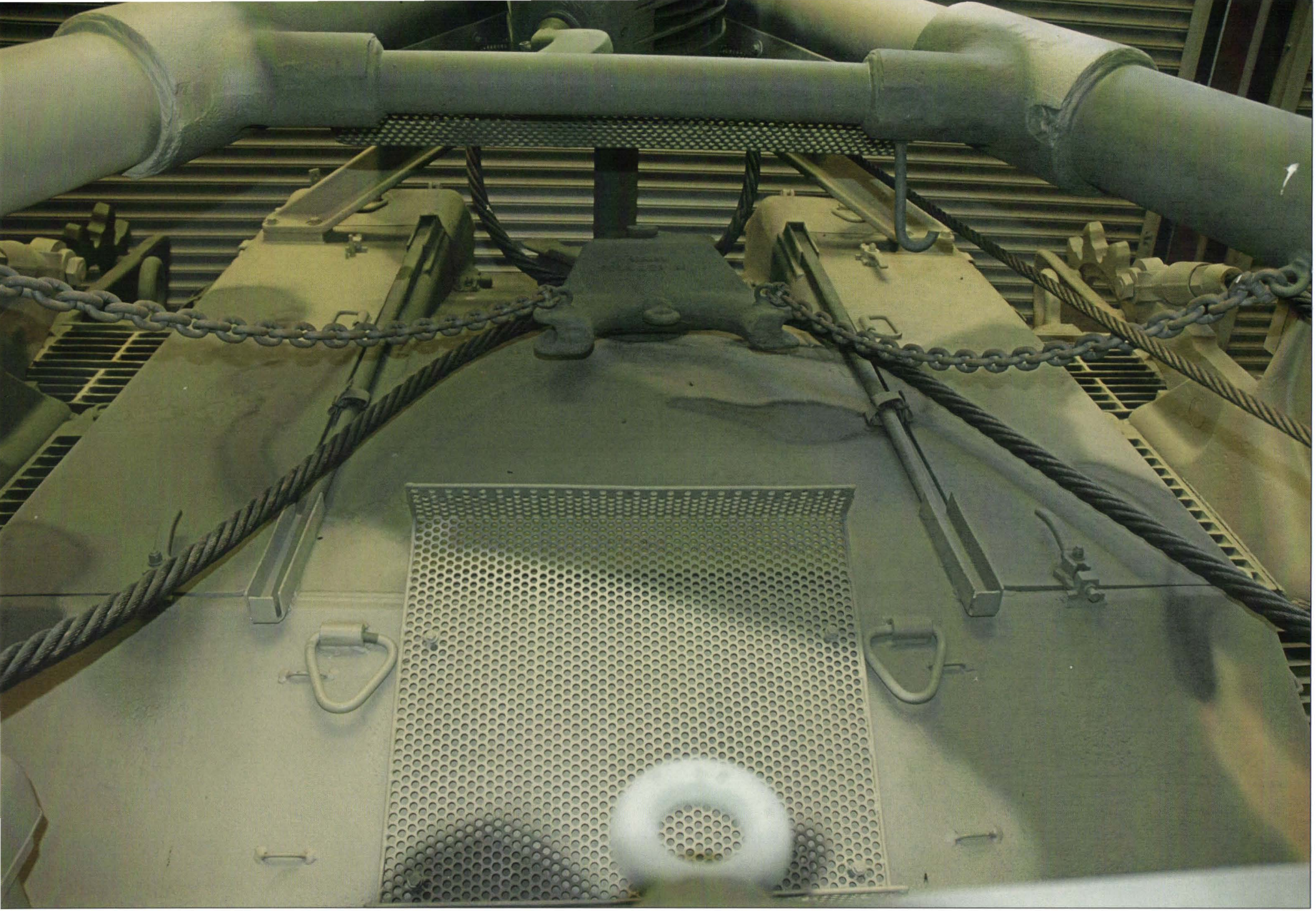


The rear of the rigger's fixed spotlight is seen here. Several of the raised tabs where screws secure the lens flange or cover to the body of the spotlight are visible.

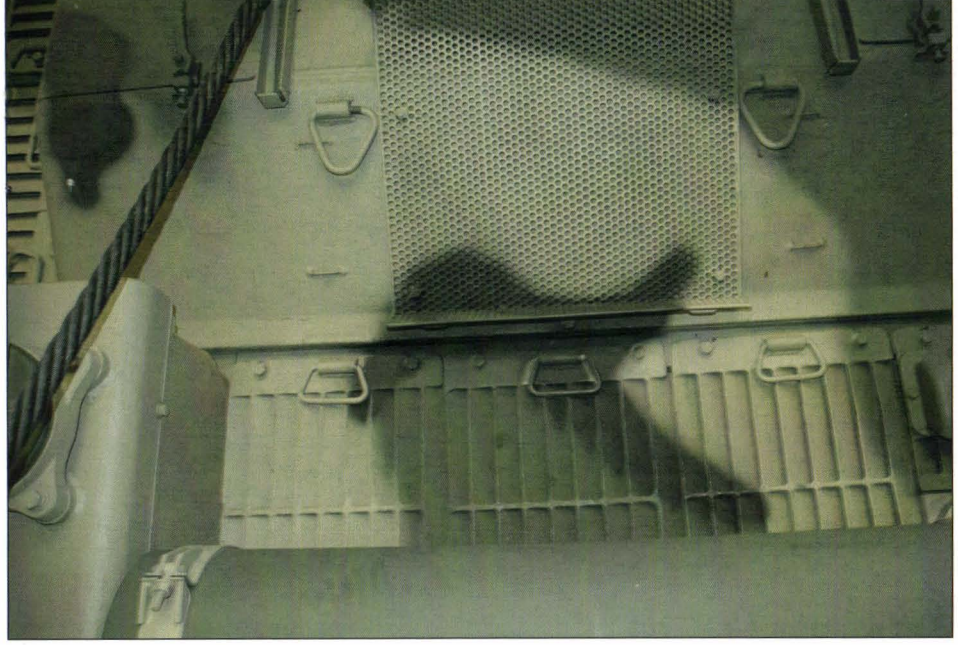
Below the oxygen bottle at the rear of the crew compartment is the fuel filler cap. The air inlet doors are removed, revealing the compartment below.



An M88 employs its front spade in a decidedly disapproved application: digging an emplacement for Troop B, 3rd Battalion, 4th Cavalry, in the Iron Triangle area northwest of Saigon in January 1967. The spade was not intended for bulldozing and could be severely damaged as a result. An improvised gun shield has been installed over the commander's cupola.

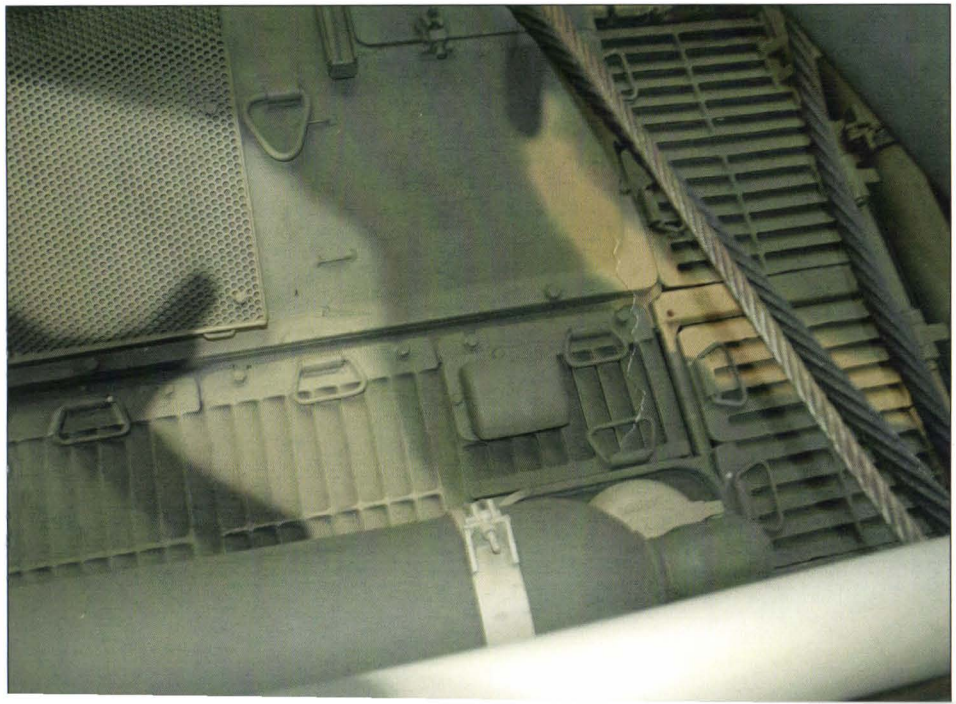


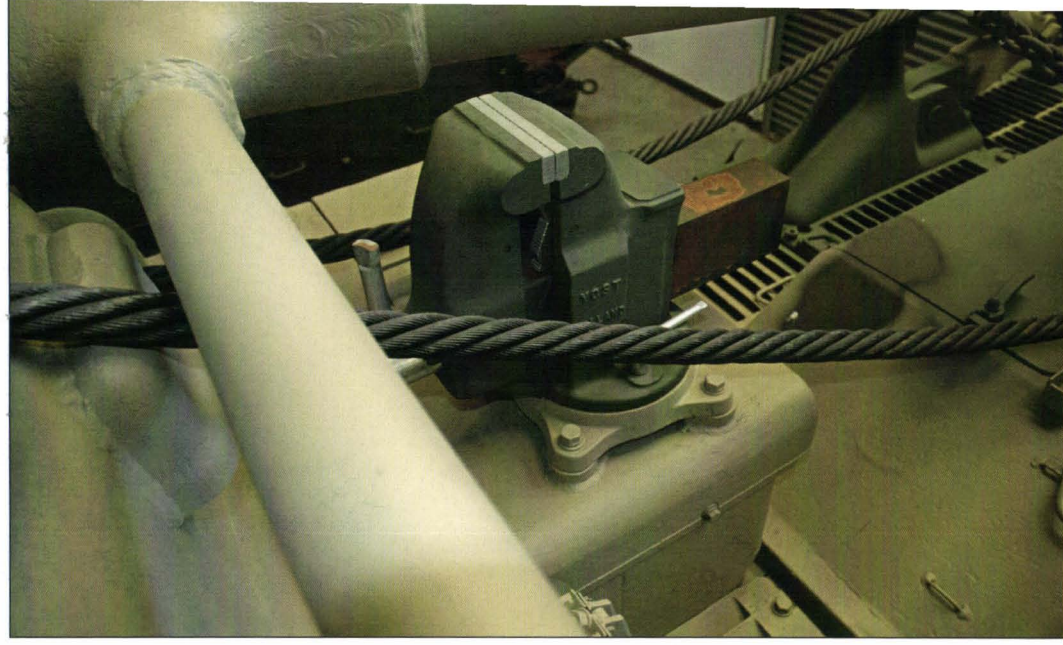
The rear (or engine) deck of the M88 is seen from the rigger's hatch. The boom is toward the top, while the circular object at the bottom center is an eyebolt on the lower crossmember of the boom. The perforated tray in the foreground is a storage rack for a tarpaulin. To either side of the tray and extending toward the rear are two crowbars in their retainers.



Viewing the rear deck from the rear of the crew compartment roof, at the bottom is an oxygen cylinder for the oxy-acetylene welding system, stored in its brackets. To the rear of it are the front air inlet grilles with grab handles, the tarpaulin storage rack, and, flanking it, the tie-down rings. To the far left are the base for a vise and, to the rear of it, part of the right intake grille.

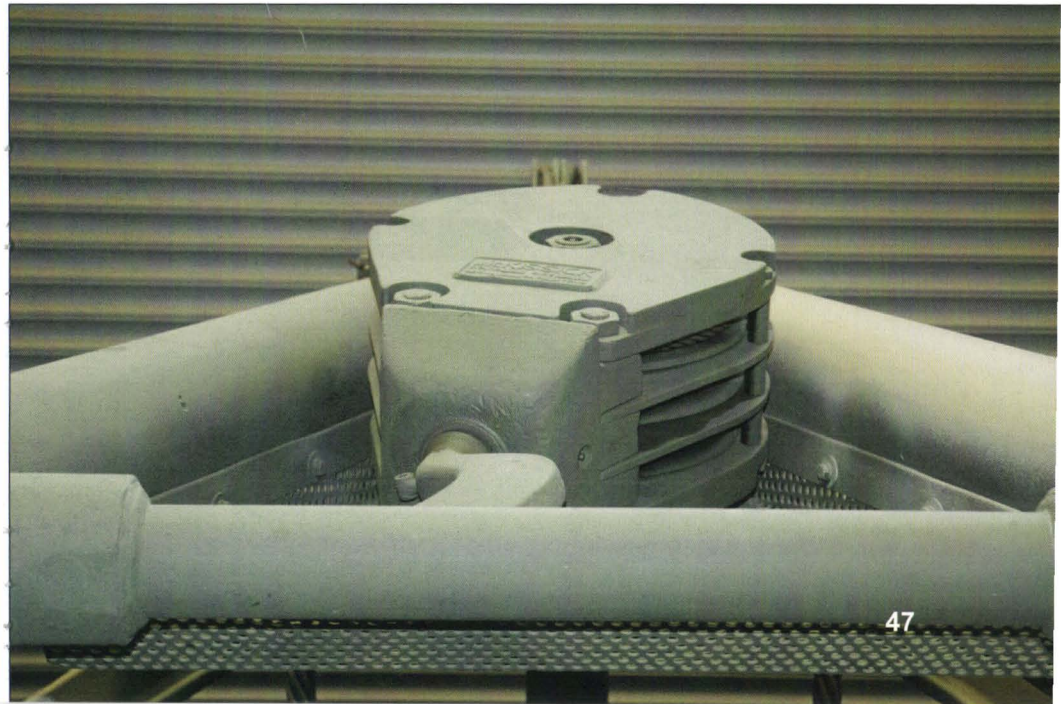
The forward left part of the engine deck is viewed from the rigger's hatch, showing the front air inlet grille and, to the right, the left inlet grille.





A vise is mounted on top of the APU access cover. The rear of the crew compartment is to the lower left.

The McKissick three-pulley hoisting block is shown stored between the apex of the boom and the upper crossmember (foreground). Using the lifting advantage offered by the hoisting block and the boom sheave, the M88 could hoist up to 50,000 pounds. The hook on the near side of the hoisting block is secured to the cast steel top of the block. The sides of the block are made of plates secured by nuts and bolts.

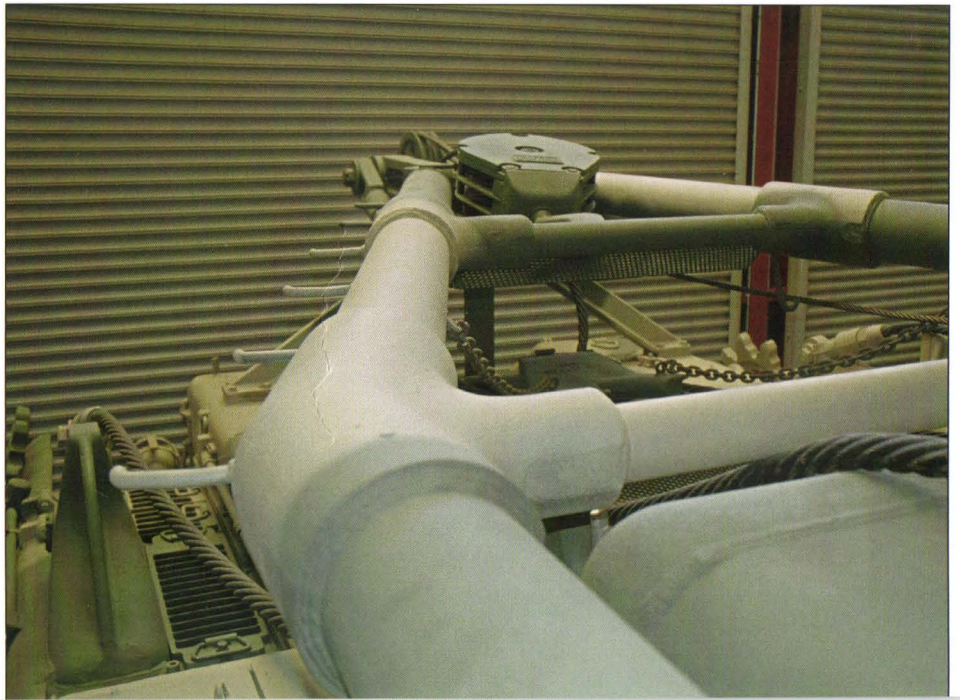


The boom staylines are attached to crank arms on either side of the engine deck. The crank arms are mechanisms that are linked to hydraulic cylinders inside the vehicle, acting to provide four feet of backward and forward movement to the boom. This principle is called "live boom."

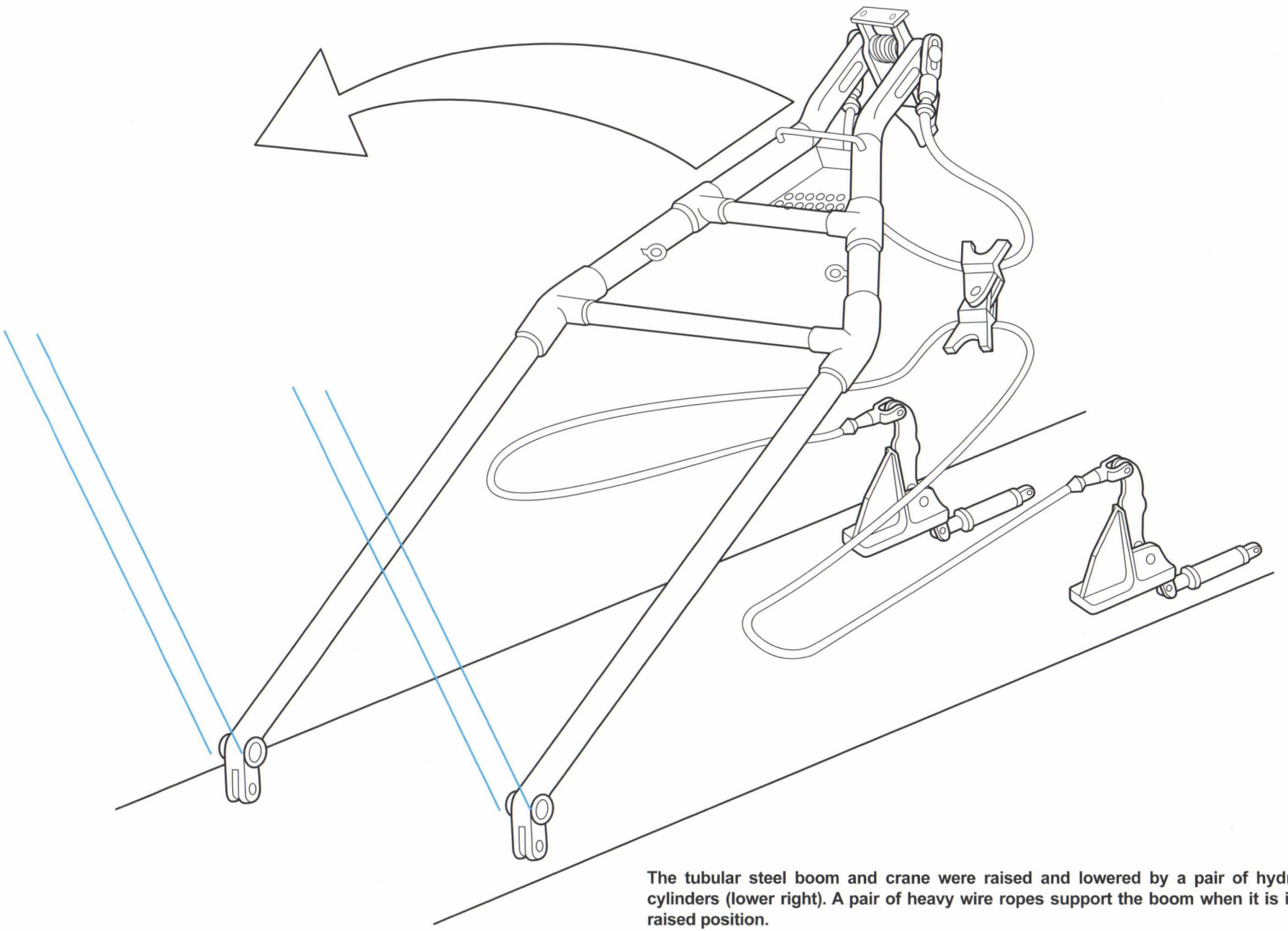
To the rear of the APU housing in the center foreground is the right crank arm, with a cable stay attached to it. The tilted angle iron toward the rear of the engine deck is the right leg of the boom support.

A view over the side of the vehicle shows the right-side crew compartment door open. A five-gallon liquid container is stored on a holder on the inside of the door. To the lower left is a radio antenna mount and guard.

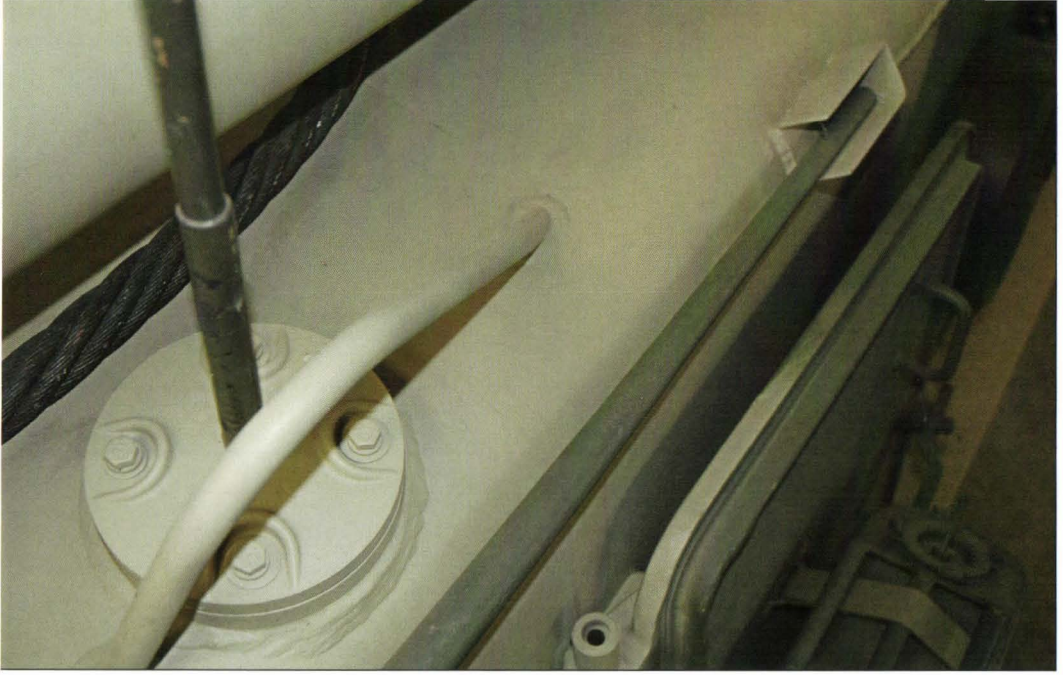
Another view of the boom and engine deck, with the rear of the crew compartment roof to the lower right. Note the rungs on the boom arm and the positioning of the boom support. The McKissick three-pulley hoisting block is resting just beyond the upper cross member of the boom.



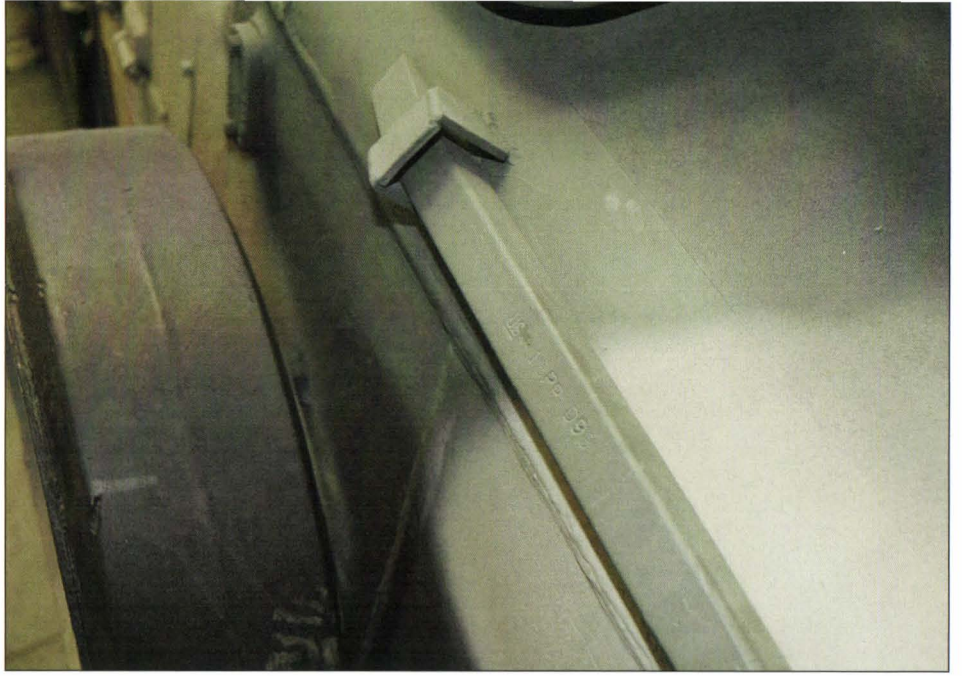
Boom and Crane Assembly



The tubular steel boom and crane were raised and lowered by a pair of hydraulic cylinders (lower right). A pair of heavy wire ropes support the boom when it is in the raised position.



Over the right crew compartment door is the base of the radio antenna. The right boom arm is to the upper left. Near the bottom of the photo can be seen the handle of a pry bar, one of the dozens of tools furnished with these retrievers.



The business end of the pry bar is at the center, secured by a small bracket. Below it, to the lower left, is the top of a spare bogie wheel, with the seam in its rubber tire being apparent.

An M88A1, the Diesel-powered variant of the M88, prepares to ford a stream in South Korea during the joint U.S.-South Korean maneuver "Exercise Team Spirit '86." A thick layer of dust coats most of the hull, while exhaust residue stains the rear of the vehicle. (Department of Defense)

This M88A1 tows an M1A1 Abrams off a Roll On/Roll Off cargo ship during Operation Desert Shield. Since the Abrams weighed too much for the M88A1 to recover safely in field conditions, the more heavy-duty M88A2 was developed to handle the massive tank. (Department of Defense)

Specifications

General Data

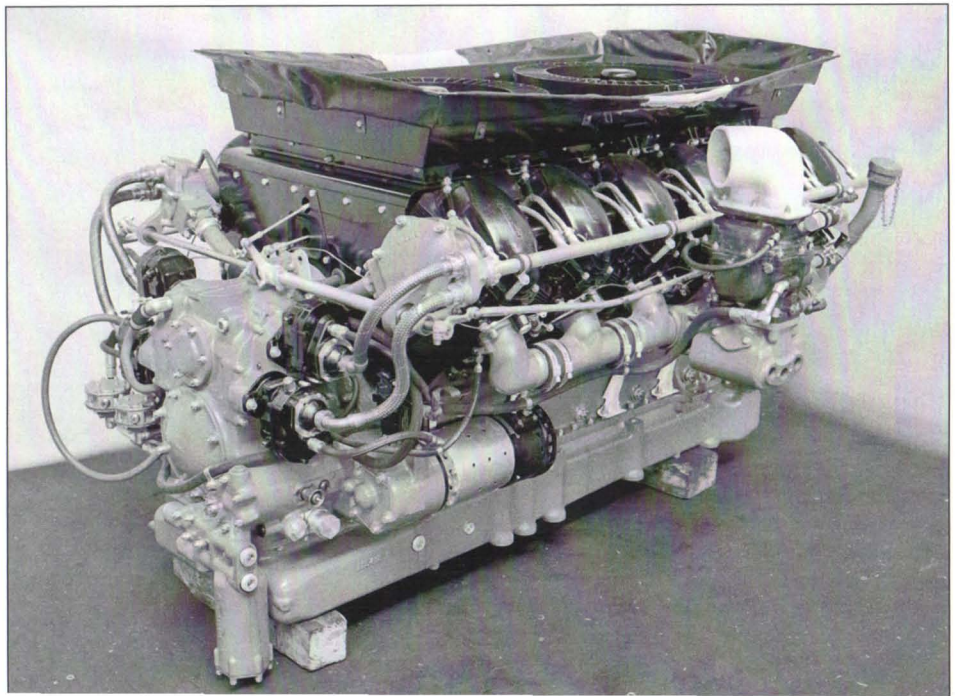
MODEL	M88	M88A1
WEIGHT^	112,000 pounds	112,000 pounds
LENGTH*	325.5 inches	325.5 inches
WIDTH*	135 inches	135 inches
HEIGHT*	115 inches	115 inches
TRACK	135 shoes	135 shoes
TRACK WIDTH	28 inches	28 inches
MAX SPEED	30 mph	26 mph
FUEL CAPACITY	445 gal.	400 gal.
RANGE	222 miles	300 miles
ELECTRICAL	24 volt negative ground	24 volt negative ground
TURNING RADIUS	Pivot	Pivot

Engine Data

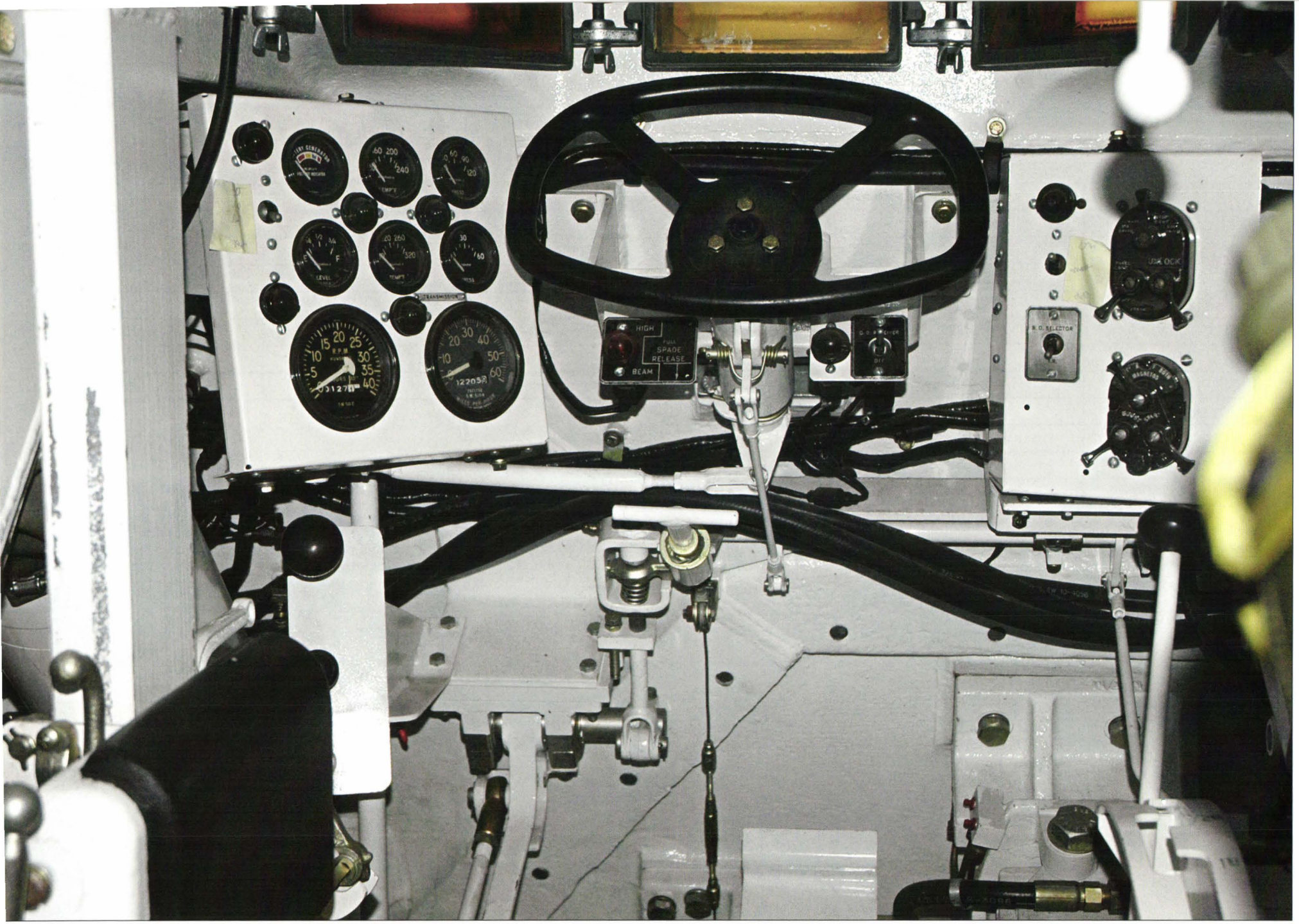
VEHICLE MODEL	M88	M88A1
ENGINE MAKE	Continental	Continental
ENGINE MODEL	AVSI-1790-6A	AVDS-1790-2DR
CYLINDERS	90 degree V-12	90 degree V-12
DISPLACEMENT	1,790 cubic inches	1,790 cubic inches
HORSEPOWER	980 @ 2,800 rpm	750 @ 2,400 rpm
TORQUE	1940 @ 2,800 rpm	1842 @ 1,800 rpm
GOVERNED SPEED	2,800 rpm	2,400 rpm

*Overall dimensions listed in inches.
^Fighting weight.

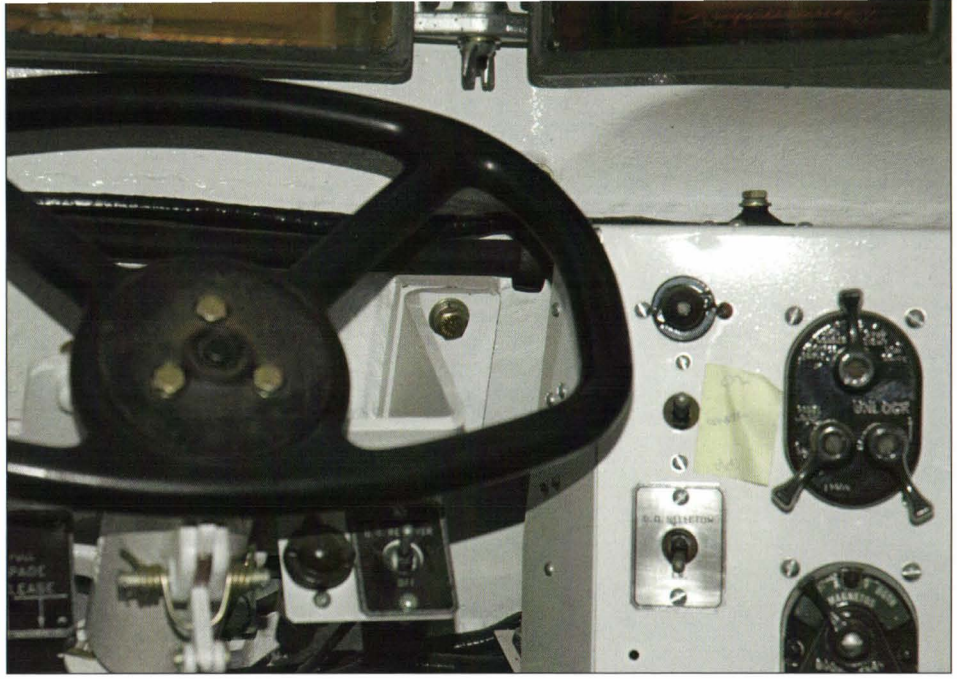
The M88 is powered by a 980 horsepower Continental AVSI-1790-6A fuel-injected gasoline engine, which is an improved version of the naturally aspirated AV-1790-5a shown here. The engines are a V-12 configuration. (TACOM LCMC History Office)



The M88A1 is powered by the 750 horsepower AVDS-1790 supercharged Diesel engine. Like its gasoline-powered predecessor, the engine is a 90-degree V-12 configuration with a 1,790-cubic-inch displacement. (Quartermaster Museum)

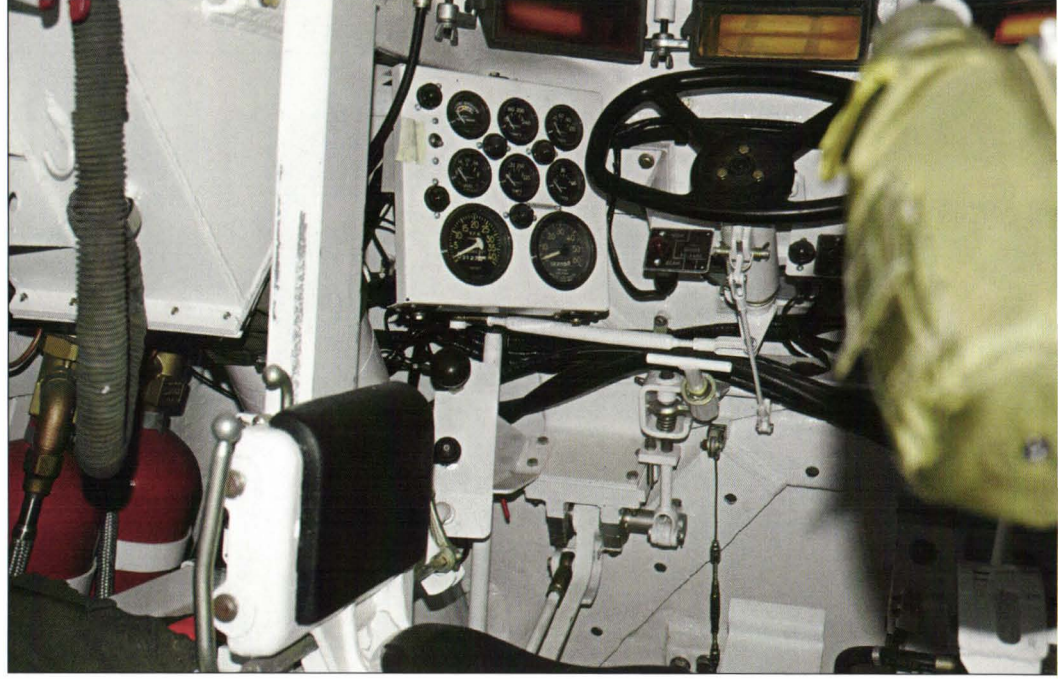


To the left of the steering wheel in the driver's compartment is the gauge panel, and to the right is the main switch panel. Below and to the front of the steering wheel are steering linkages. Over the steering wheel are three periscope objectives and their retainer wing nuts.



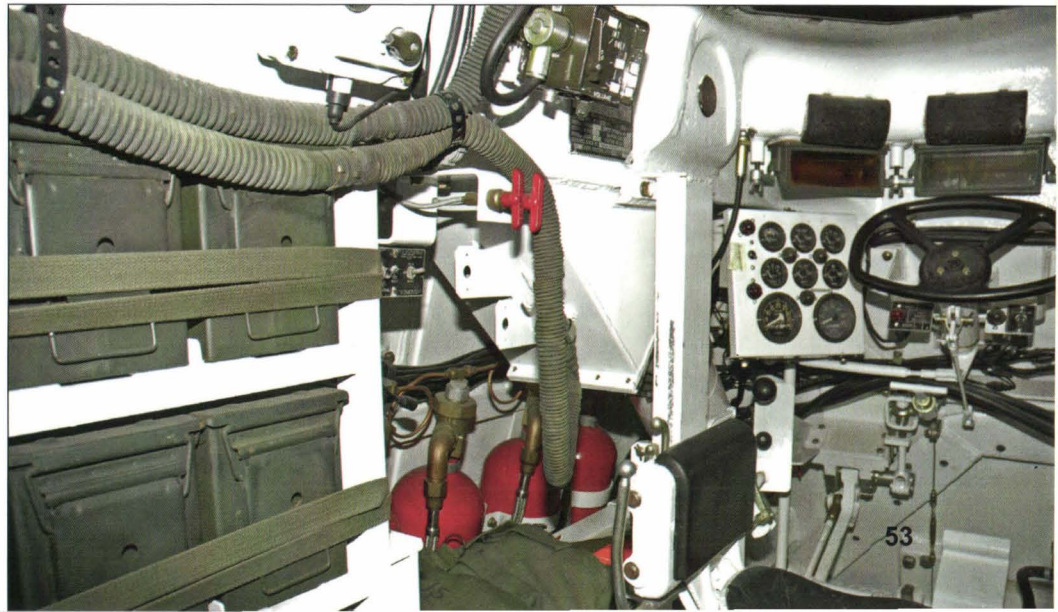
On the right side of the main switch panel are the master lighting switch and blackout/ infrared selector switch. To the right side, top, is the main light switch, with the starter switch below it. Below the right bottom of the steering wheel is the blackout receiver switch and indicator.

The top row of gauges on the gauge panel are, left to right, the battery generator voltage indicator, engine temperature, and engine pressure. Middle row: fuel level, transmission temperature, and transmission pressure. Bottom row: tachometer and speedometer/ odometer. Also on the panel are warning lights, instrument panel lights, and fuel selector switch.



The vertical stanchion to the left of the gauge panel is called the seat support. The fixture with black padding next to it is the seat frame, which slides up and down the seat support, and to which the folding seat (bottom center) is attached. Partially hidden beyond the support is the left boom actuating cylinder. At the upper left is the housing for the boom operating lever, to which the piston of the actuating cylinder is coupled.

The four fixed fire extinguishers on the left side of the M88 are stored forward of the storage racks for .50-caliber machine gun ammunition boxes. The fire extinguishers comprise a central system that is plumbed into a network of lines to provide fire-extinguishing coverage to the entire interior of the vehicle.



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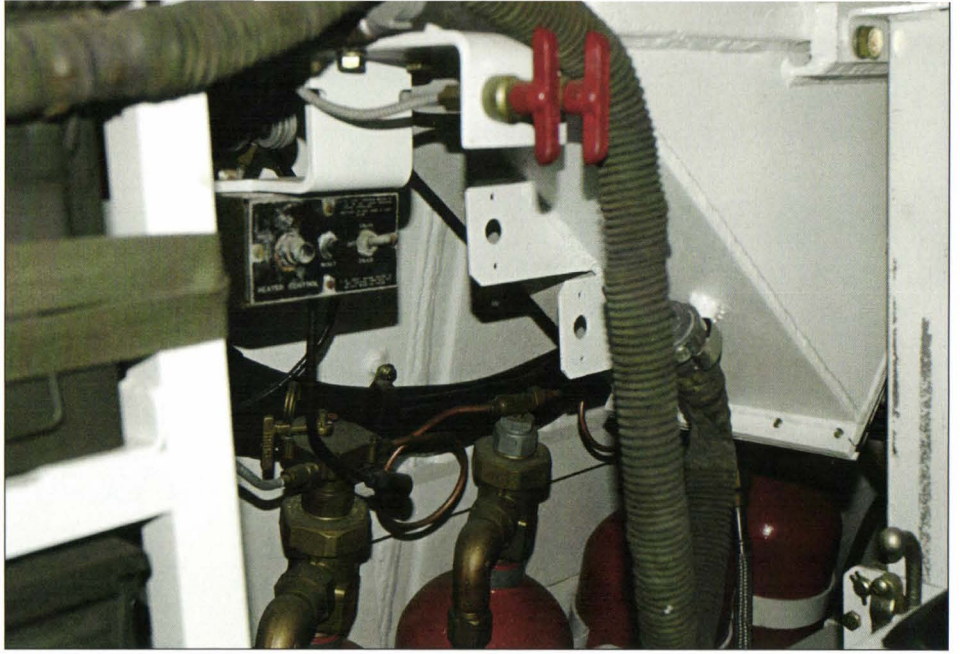
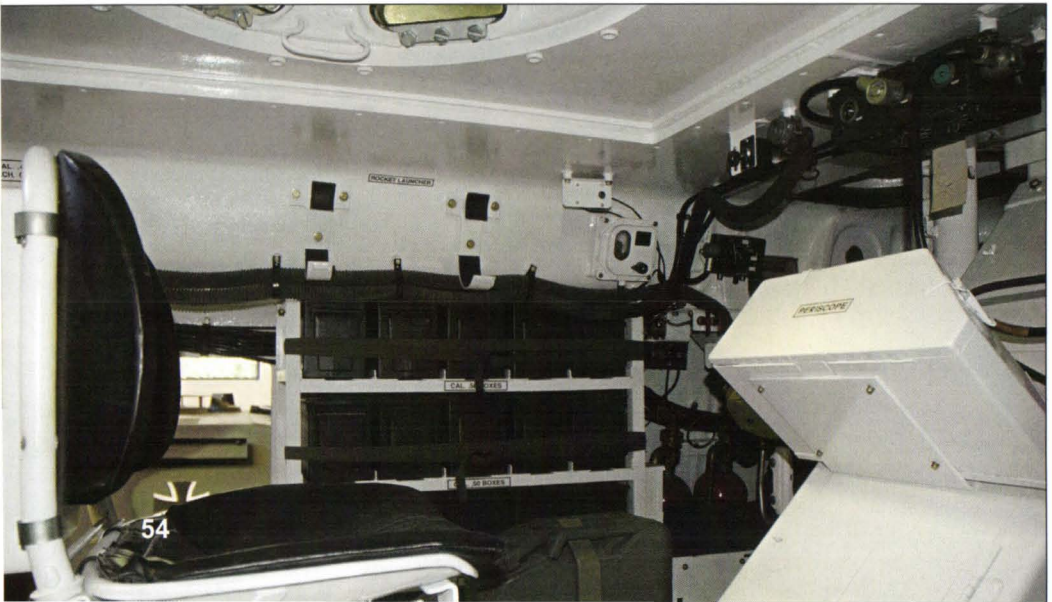
The commander's seat is an intricate assembly mounted on the floor below the commander's cupola. It can be articulated in various ways, including raising and lowering and moving forward and to the rear. The sloping enclosure to the right with the periscope storage box mounted on it is the boom cable housing (also called the wire rope shield), which encloses the cable running from the boom winch below the floor up through the roof and to the boom sheave when the boom is deployed.



The two red handles above and to the rear of the fixed fire extinguishers are manual actuating controls for the right and left extinguishers. The black switch panel below them is the heater control. The hose is part of the M8A3 gas/particulate filter system, and provided purified air to the driver via a face mask in the event of a nuclear-biological-chemical (NBC) attack.

Several of the viewing prisms and the wedge plates that hold them in place in the commander's cupola are at the top. Above the machine gun ammunition boxes are storage brackets for two LAW antitank rocket launchers. A dome light is immediately to the top of the forward end of the ammunition rack, toward the right of the photo. Also visible are various gas/particulate filter system hoses.



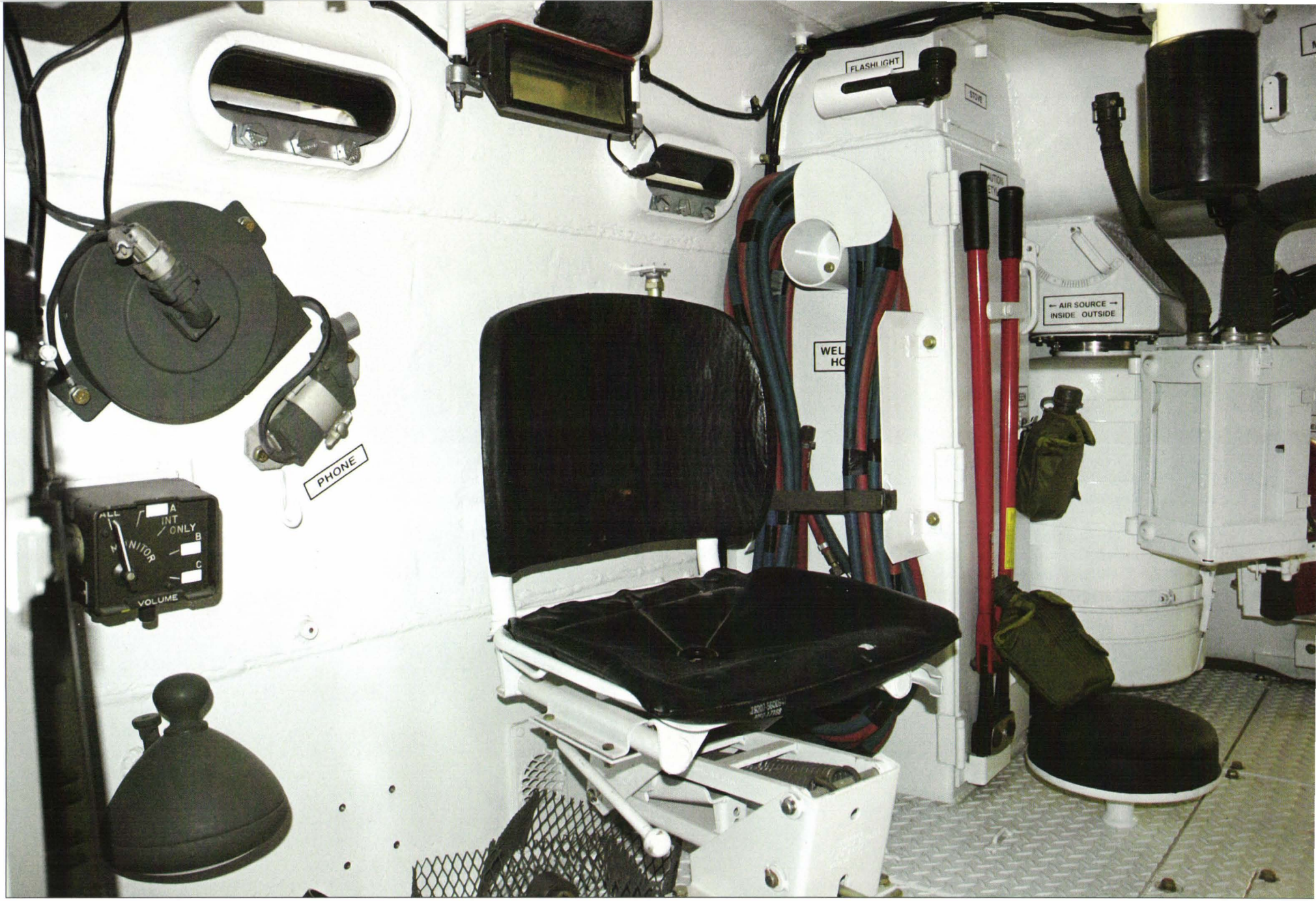
The crew compartment appears through the left side door. The commander's seat and cupola are to the far left. The white box to the left of the fire extinguisher is an M2A2 gas-particulate filter; another one is on the opposite side of the compartment. Beyond and below the purifier is the rigger's seat, and above it at the rear of the roof is the rigger's open hatch. The hatch opening mechanism is the cylindrical object on the roof next to the hatch.

Forward of the open left crew compartment door of the M88 are the .50-caliber ammunition racks. The bottom shelf was intended for storing heavy items. Part of the commander's seat is visible to the far right. Each box contains 100 linked rounds of ammunition, arranged in sequences of one M17 tracer round and four M33 ball rounds.

A cupola and hatch are above the commander's seat. Immediately to the front of the seat is the boom cable housing, on both sides of which are five-gallon liquid containers secured in holders. There are protective pads above each of the viewing prisms in the cupola.

This USMC M88A1 at Cherry Point, North Carolina, is painted in the four-color Mobility Equipment Research and Development Command (MERDC) paint scheme. A spreader bar is attached to the hoist cable. (Department of Defense)

An M88A1 exits a landing craft at Pensacola, Florida, during Exercise Agile Sword '86. Covers are fitted over the smoke grenade launchers to protect them from dirt and debris. (Department of Defense)

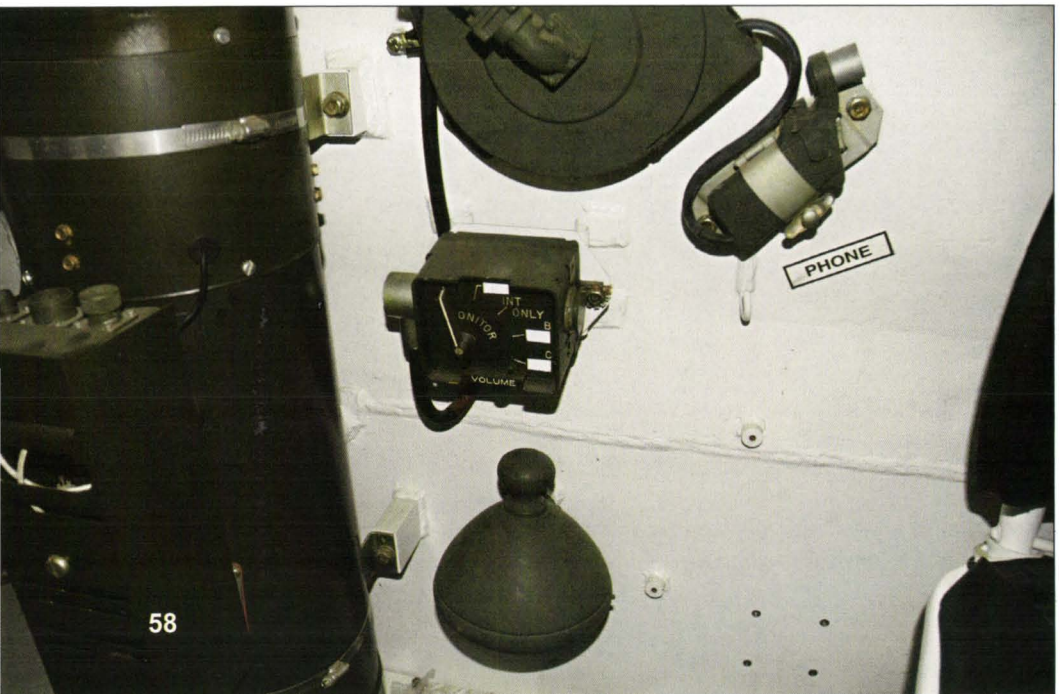


At the rear of the crew compartment is the rigger's station. Like the commander, he had a heavy-duty seat that could be configured in numerous positions. Stored on the rear bulkhead is a power cable reel for using the spotlight away from the vehicle in a trouble light configuration – the spotlight head is a separate item – below which is the rigger's intercom box, a hook for a telephone, and the spotlight itself. The welding hoses and red-handled bolt cutters are stored on a compartment containing the acetylene tank. A gas-particulate filter is to the right.

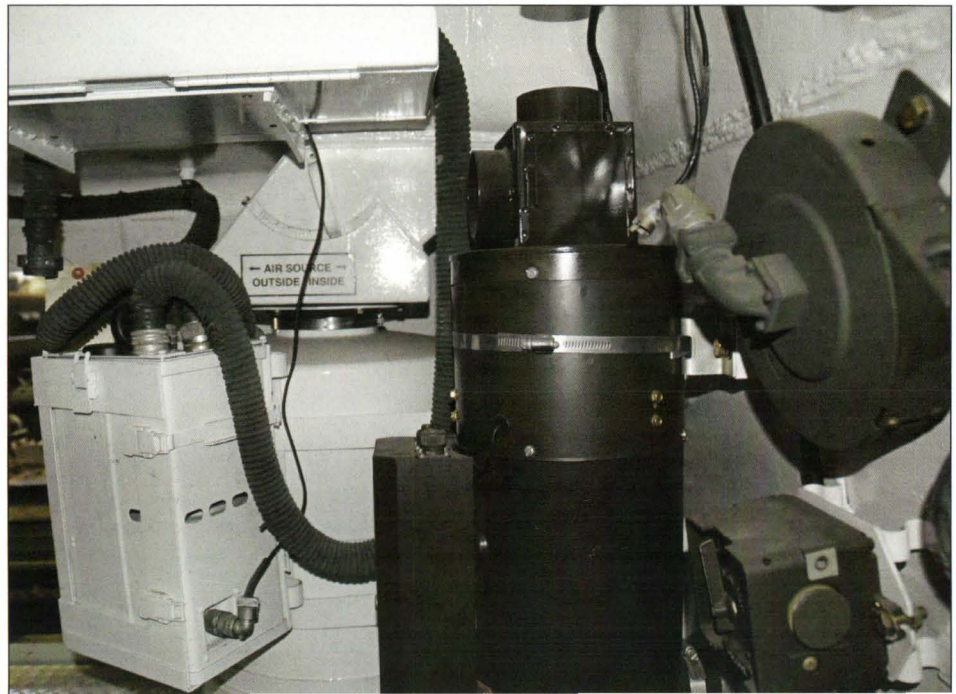
Protruding into the roof to the left of the open rigger's hatch is the control handle for the spotlight. Two vision prisms flank the rigger's periscope above his seat, and above the periscope is a forehead pad.

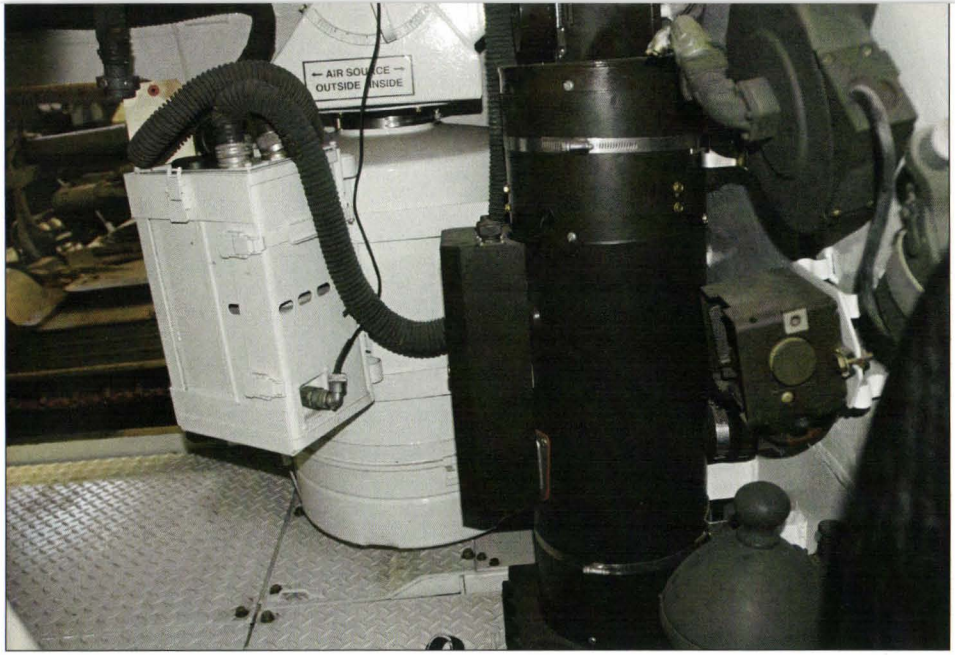
The dark colored fixture to the left of the photo is the personnel heater, near the right rear corner of the crew compartment. To the right is the rigger's seat and pedestal. On the floor is a disassembled 3.5" antitank rocket launcher.

The rigger's intercom control box, part of the personnel heater, and the trouble light reel are in the rear of the crew compartment. The hand grip above the "Phone" placard attaches to the spotlight at the bottom to form a portable trouble light.



To the left is the right-side M2A2 gas-particulate filter with air hoses for various crew stations issuing from it. To the right of center is the personnel heater. The rear bulkhead of the crew compartment is to the right.

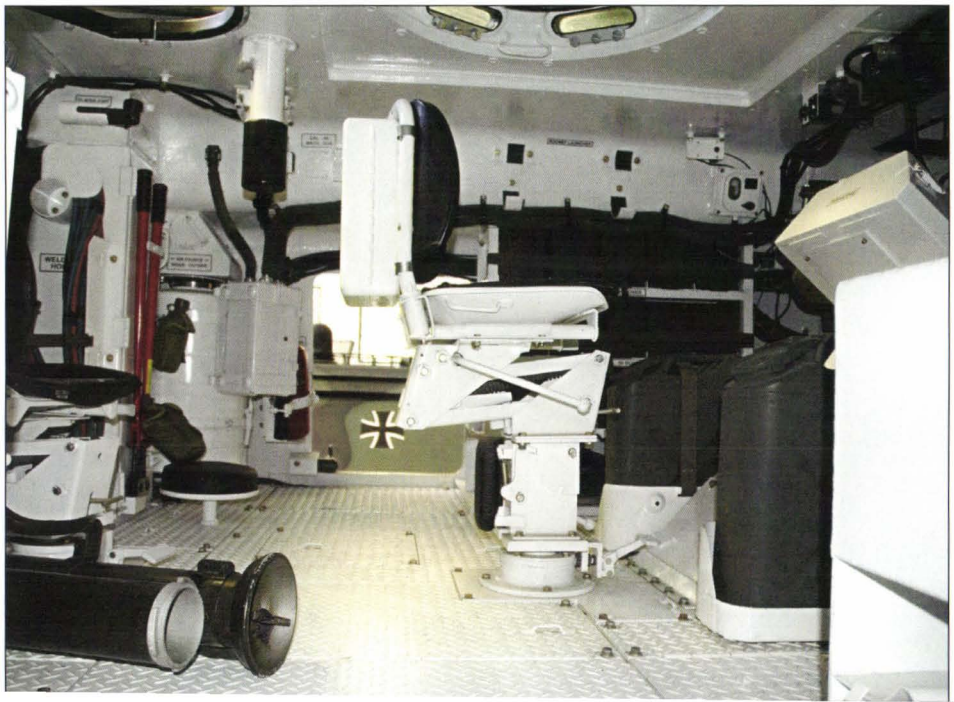




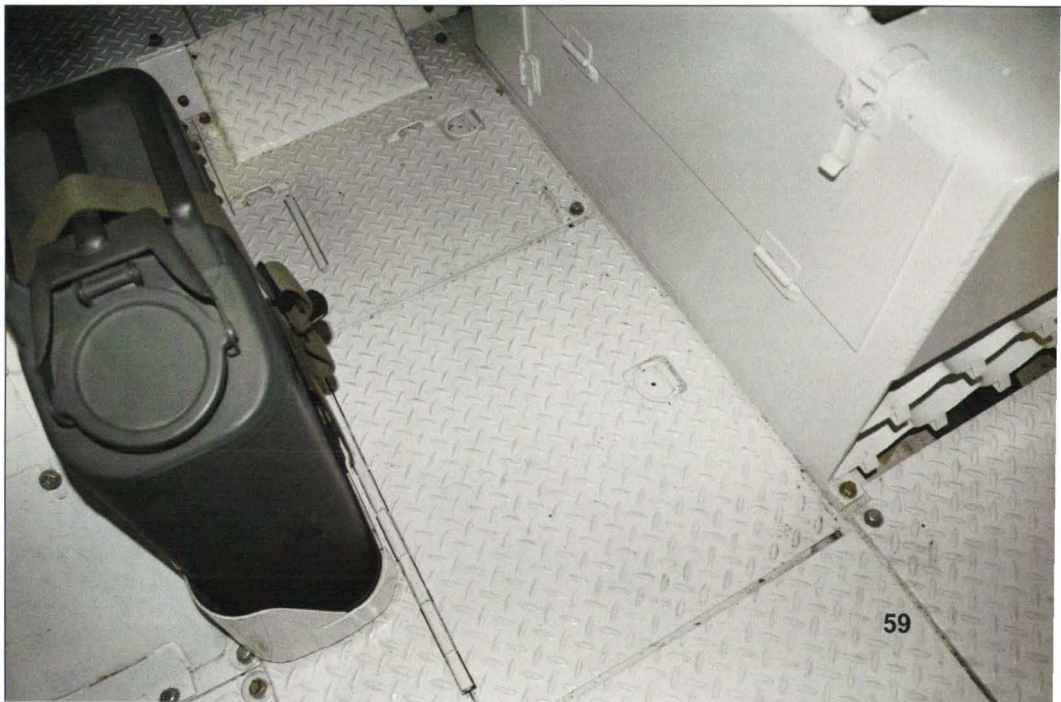
Two air cleaners for the engine are in the rear corners of the crew compartment. The right filter is the large drum between the gas-particulate figure and the heater. To the far left is the open right side door.

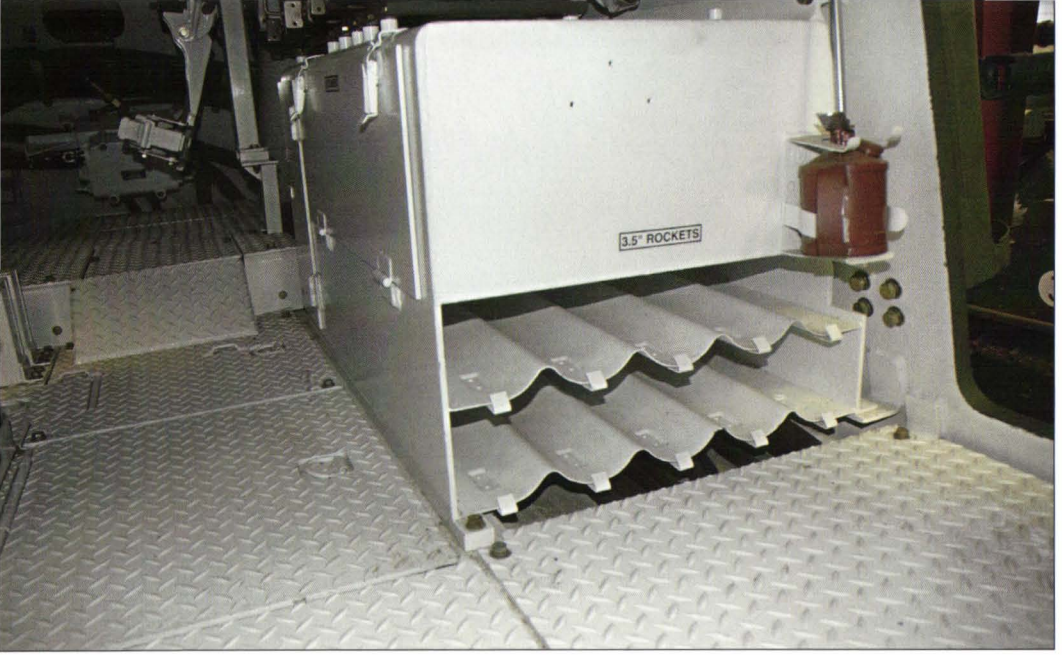
A note on the side of the air cleaner cautions that it should be drained, cleaned, and refilled every day when operating on dirt roads or cross-country, and every 250 miles when operating on paved roads or in wet weather.

This view across the crew compartment from the right side door reveals the open left side door at the center background (and beyond it, a German vehicle). The commander's seat at the center is in the lowered position, as is the rigger's seat at the far left. On the floor at the lower left is a disassembled 3.5" antitank rocket launcher.



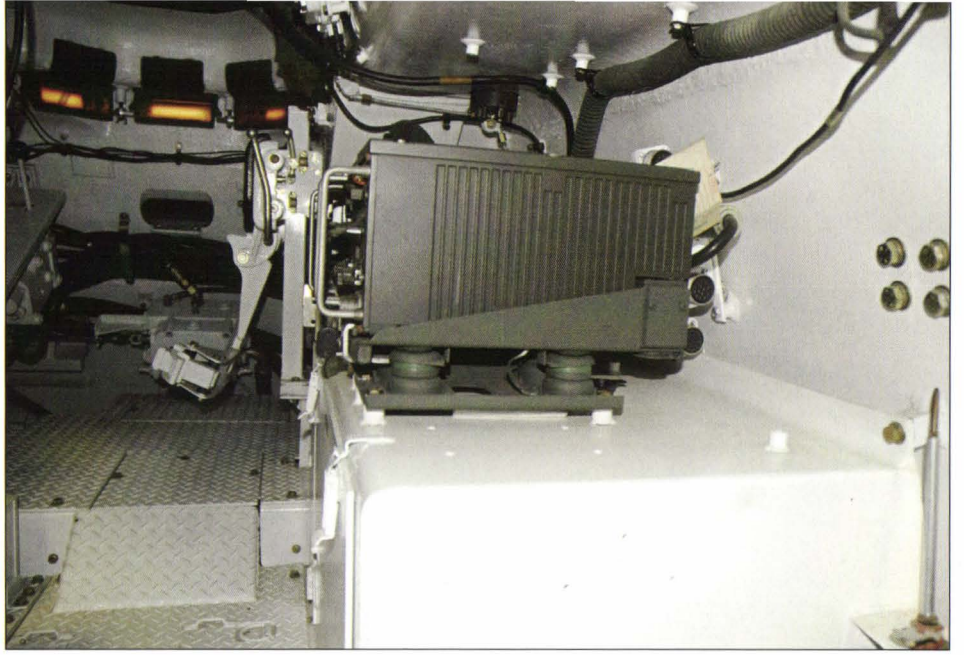
This five-gallon liquid container is in front of the commander's seat, to the right of the boom cable housing (lower left). To the upper right is an oddments container. The floor panels are removable, to allow access to the transmission, hydraulic pump, hoist winch, and other mechanisms under the floor.





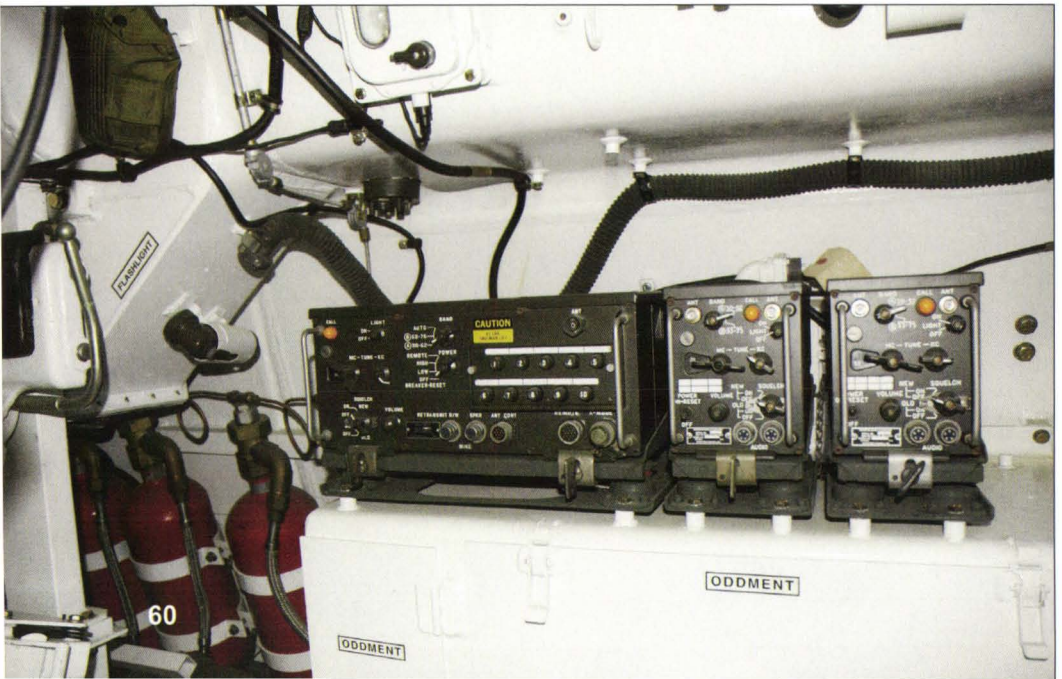
Under the oddments container, seen from behind, is storage for ten 3.5" antitank rockets, which would have been fired by an M20A1 or M20A1B1 launcher. To the right is an oil can. To the left background is the mechanic's station, with folded-up seat.

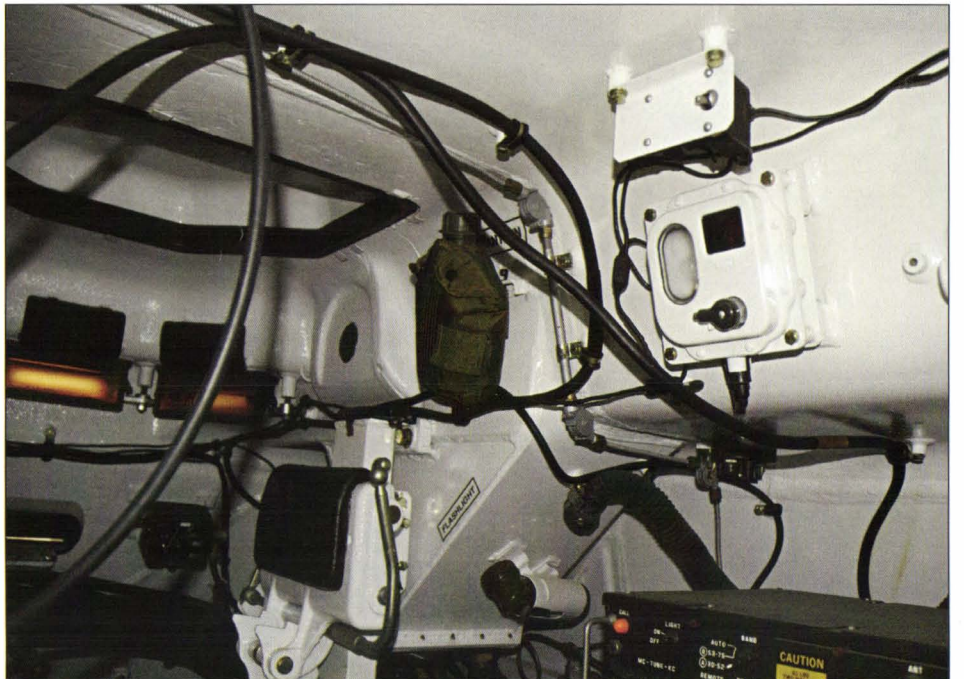
The unit to the left is a receiver-transmitter, while the two sets to the right of it are R-442A/VRC receivers. Above the receiver-transmitter is a dome light. Several of the fixed fire extinguishers are at the lower left. Stowed in a clip above the fire extinguisher tanks is an elbow-type flashlight.

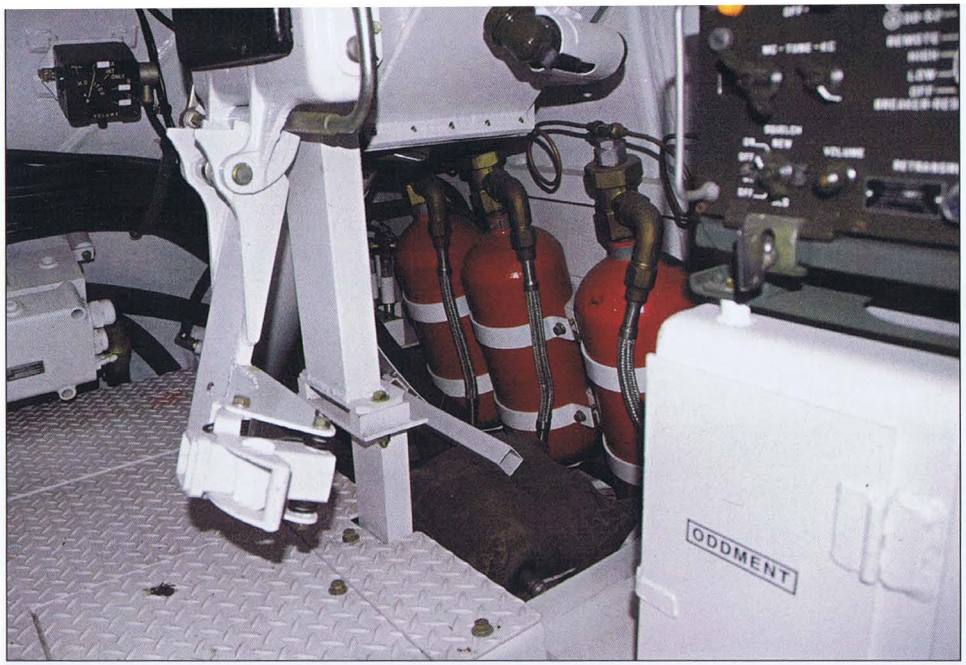


Radio transmitters and receivers are positioned on top of the oddments container on the right side of the crew compartment. In this view looking forward, the three periscopes in the mechanic's station are visible at the upper left. The contour of the roofline is visible above the radio.

Above the dome light is the air purifier control switch. To the left, or front, of the canteen is the right boom pivot, below which is the mechanic's seat support and seat frame with black padding. Attached to the frame is the operating handle.

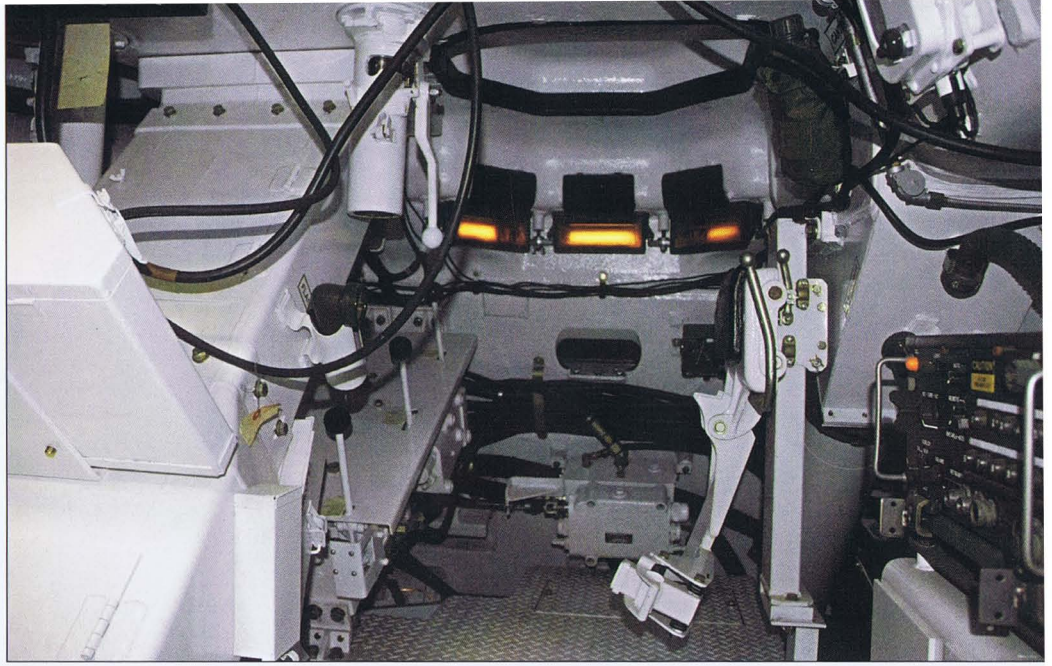




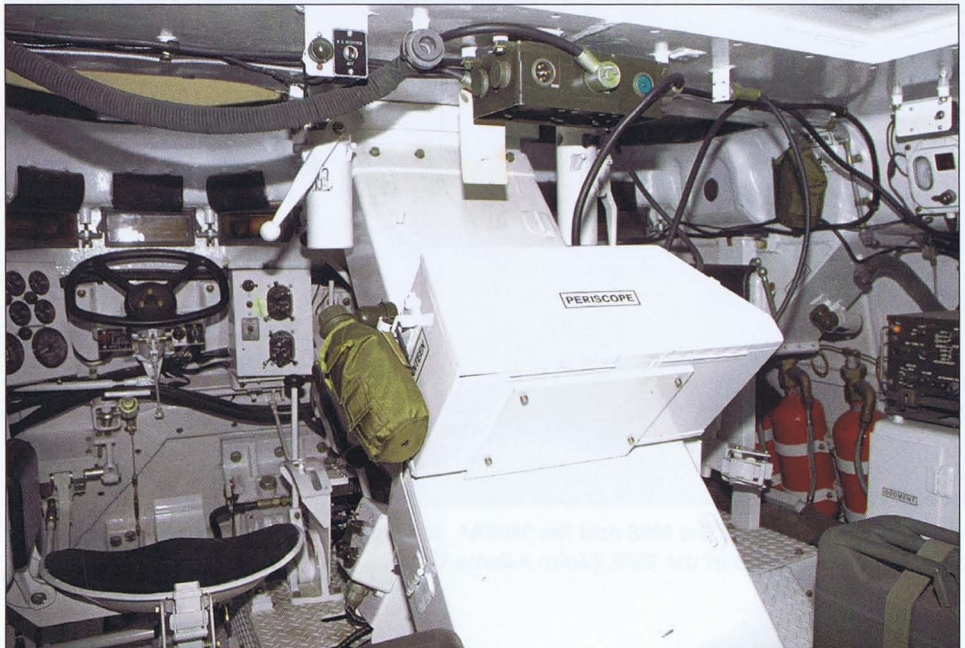


The seat pan/cushion and backrest have been removed from the folded-down mechanic's seat assembly. To the left of the assembly are the mechanic's intercom control box and, partially visible, his vision block.

The hoist mechanism is located between the driver's and mechanic's seats. A storage box for periscopes is on top of the housing. Above the stowed canteen is the opening/closing mechanism for the driver's overhead hatch door. To the left are the driver's seat, controls, and instrument panel. (Chris Hughes)



The mechanic's station is surveyed here from the rear. To the left is the hoist cable housing, to the top right of which is the operating mechanism for the mechanic's hatch. To the upper right of center is the closed hatch, with the three M17 periscopes below and to the front of it. Below the hoist cable housing to the left is the hydraulic control panel with controls for operating the boom, spade, hoisting and main winches, and main and auxiliary hydraulic systems.



The interior of the driver's hatch is seen here. (Chris Hughes)

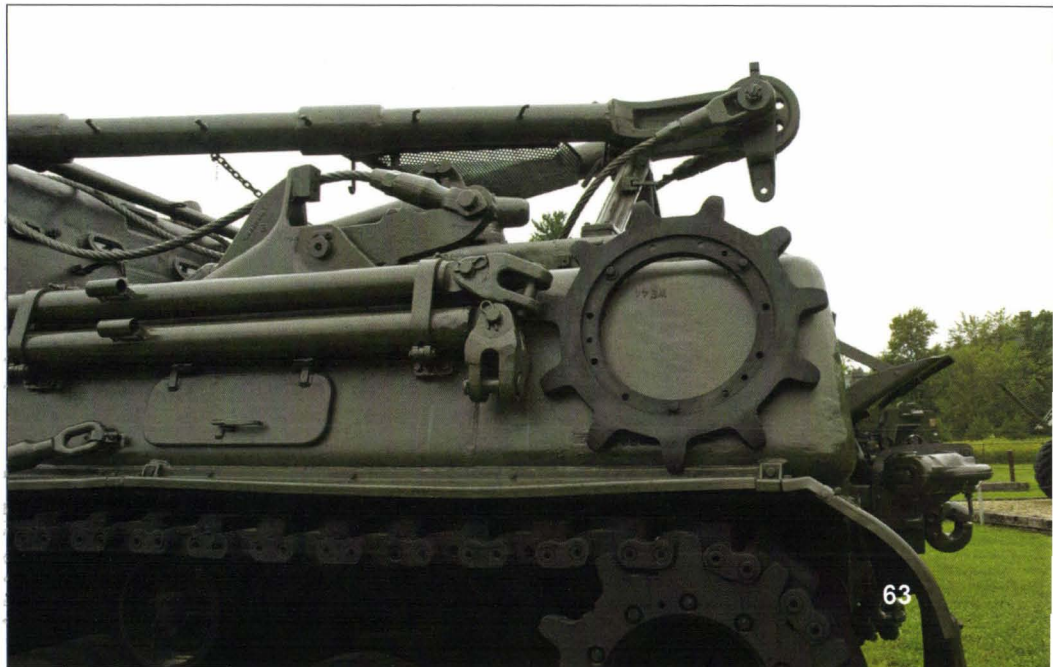
This thee-quarters front left view of an M88A1 shows that there were few visible differences in the exteriors of the M88 and the M88A1, especially from this angle. Among other improvements, the M88A1 substituted an air-cooled V-12 Diesel supercharged engine for the gasoline engine of the M88. (John Adams-Graf).

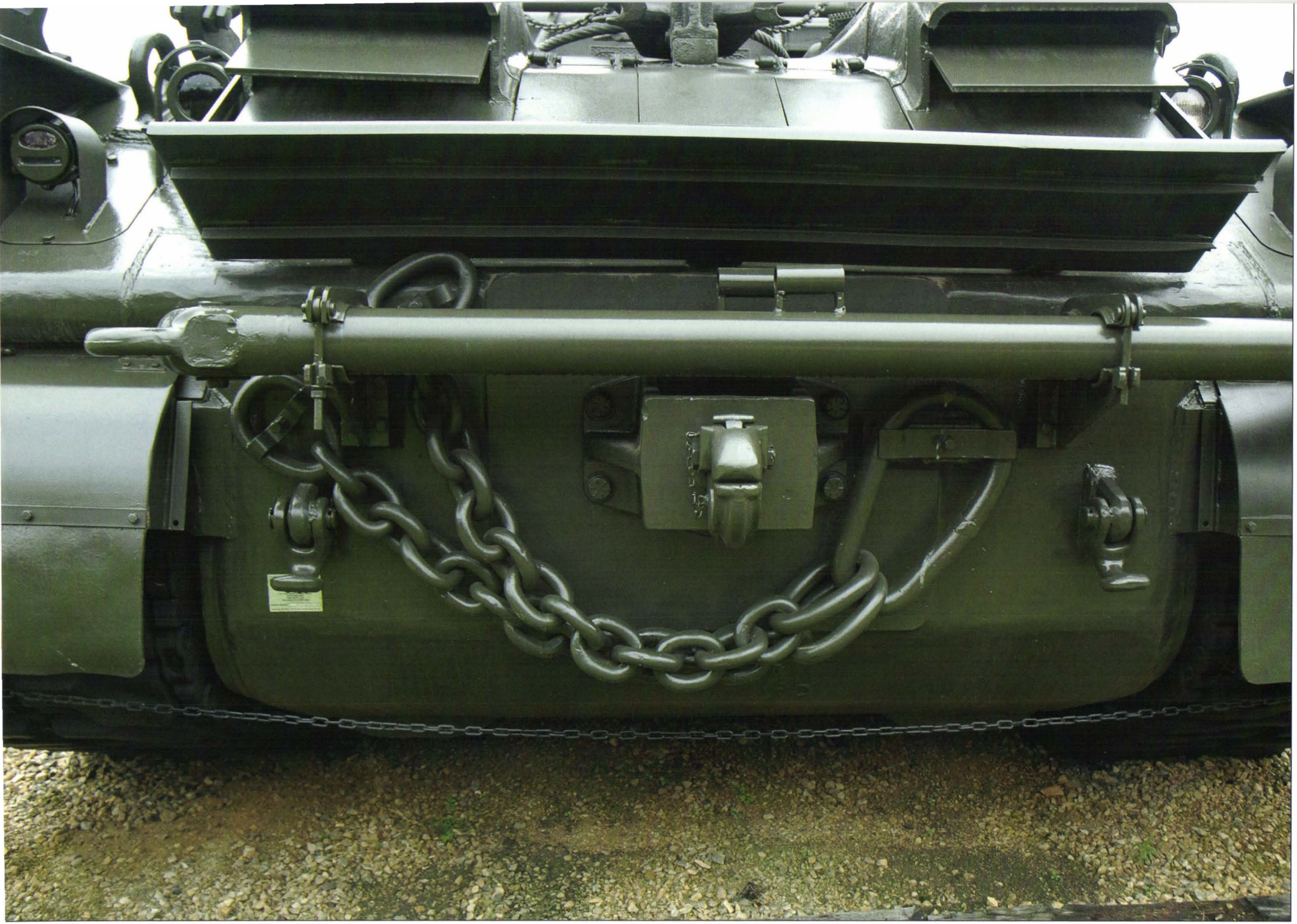
The spade is raised here. Near the front of each side of the hull are a 10-ton snatch block and three track links. Above the top link are four mounting studs for a smoke grenade storage box, not installed. The boxes on the sides and two glacis-mounted smoke grenade launchers (not installed) were M88A1 characteristics. (John Adams-Graf)

Below the spare return roller is the cover for the external actuating handle for the internal fire extinguisher system. The boom pivot is on the roof above the spare track links. (John Adams-Graf)

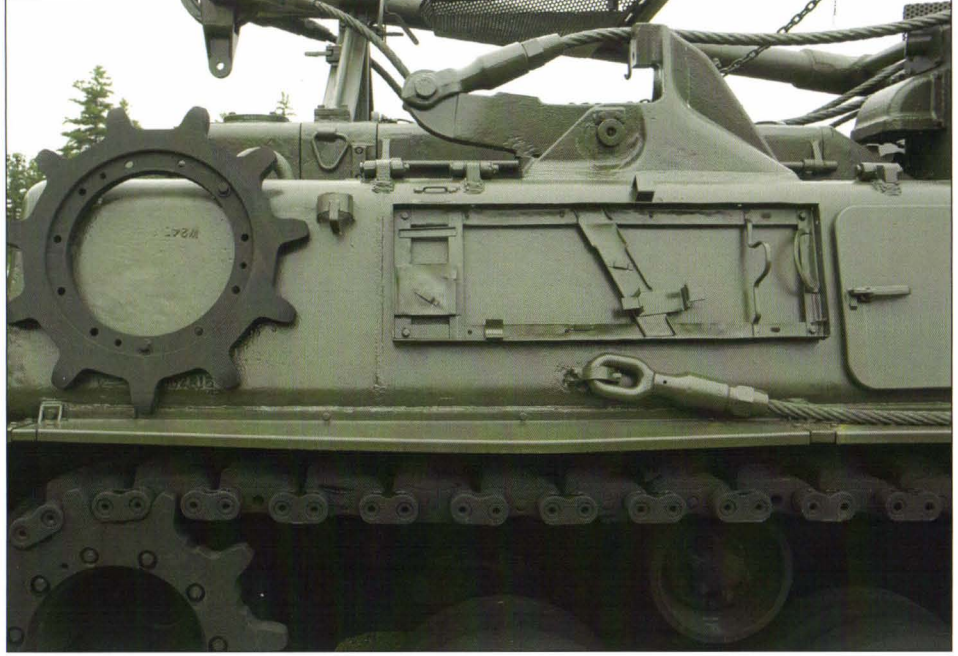
To the rear of the left side door are a spare road wheel and tow bar. The door hinge incorporates a torsion bar. There are grab bars and a grab handle over and to the rear of the door. (John Adams-Graf)

A spare sprocket is stored at the rear of the left side of the hull. Below the tow bar assembly is the door to a small storage compartment. The stowage compartment door has a rubber gasket around the perimeter of its inner side, to keep the compartment weatherproof. (John Adams-Graf)





A tow bar and tow chain are stored on the rear of this M88A1. There are two handles on the tow bar assembly. The tilted panel above the tow bar is the exhaust deflector, a hinged, adjustable assembly. (John Adams-Graf)

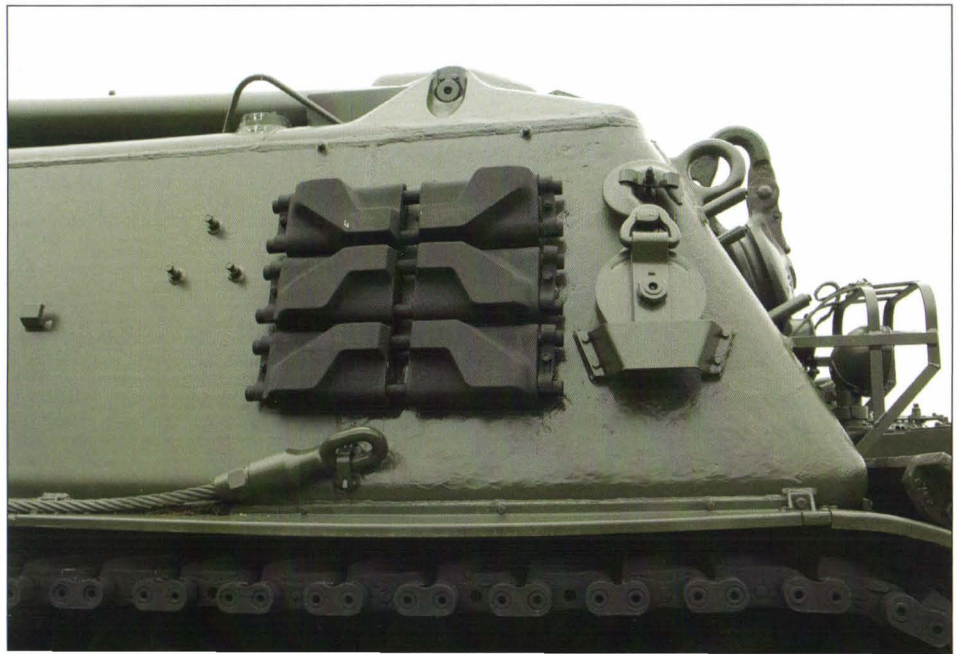


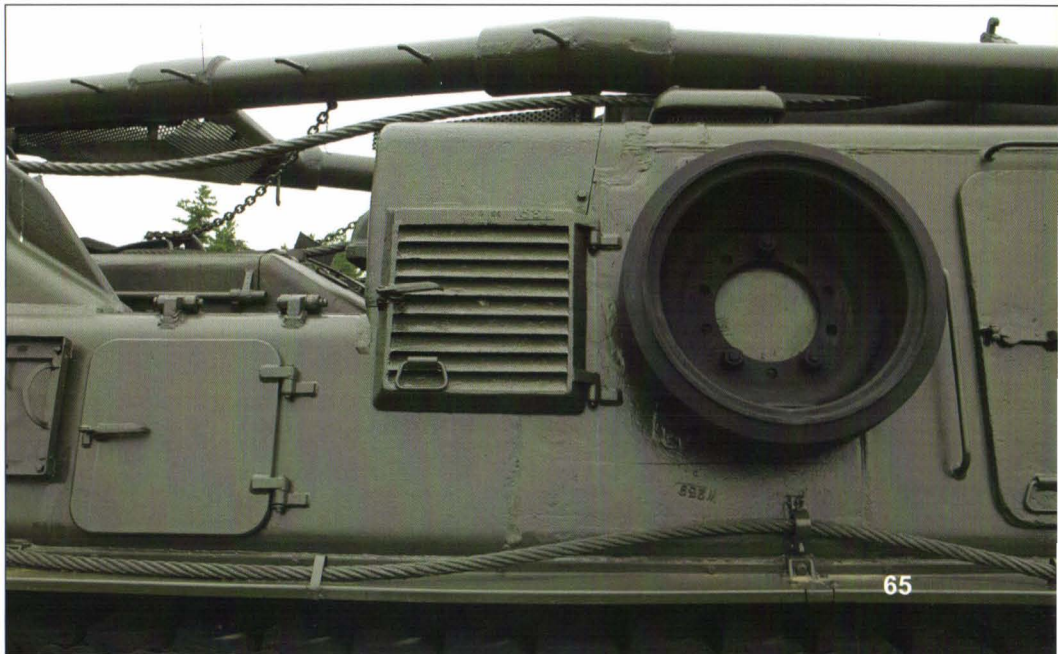
The right rear of the hull of the M88A1 displays a spare sprocket, pioneer tool rack, and tow cable. Above the tool rack is the right crank arm, to which the lower end of the boom stay is secured. Powered by hydraulic cylinders inside the vehicle, the crank arms provide four feet of front and back movement to the boom. (John Adams-Graf)

Stored at the front end of the side of the hull are three spare track links and a 10-ton snatch block. The three lugs to the rear (to the left) of the track links are for mounting a spare return roller. The eye of the tow cable toward the bottom center is secured in place with a clamp-type bracket. (John Adams-Graf)

The apex of the boom, the sheave, and the attachment point of the right stay are seen from the right rear of the M88A1. The mesh tray is intended to hold the hoisting block when the boom is in the stored position. (John Adams-Graf)

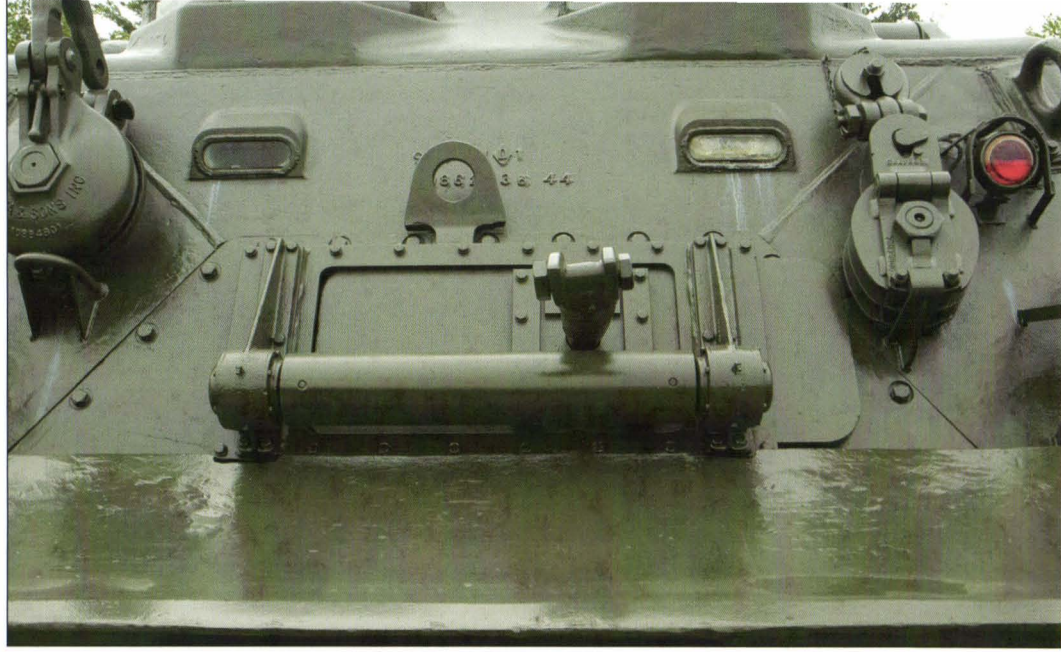
To the rear (or to the left) of the spare road wheel is the armored housing for the auxiliary power unit (APU) and its louvered door, which not present on the M88. Behind the small door to the left of the APU door is a compartment containing a pneumatic coupling for running compressed-air tools. To the far right is the right side door to the crew compartment. (John Adams-Graf)





The spade on the front of this M88A1 is raised. With the smoke launchers removed, the front of this vehicle appears virtually identical to the front of an M88. (John Adams-Graf)

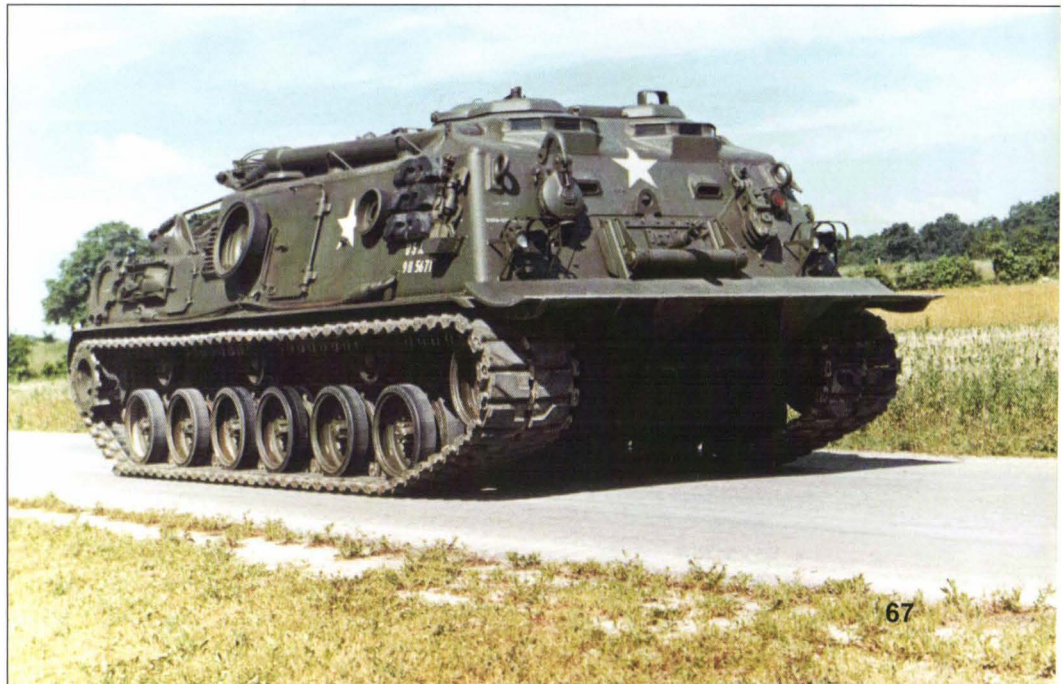
Above the left headlight are three mounting lugs (two upper and one just above the horn behind the light) for a smoke grenade launcher, not installed on this vehicle. Next to the Sowa & Sons 90-ton snatch block is the mechanic's vision block, with the mechanic's cupola, periscopes, and hatch above. (John Adams-Graf)



Centered on the glacis behind the spade is the main winch housing, secured to the glacis with hex bolts. The end of the dragline cable is projecting through the half-bushings and is resting on the cable roller. There are casting marks on the glacis behind the lifting eye on the winch housing. (John Adams-Graf)

Outboard of the 25-ton snatch block stored at the top left of the glacis of the M88A1 is a flashing, red signal light. Above it is a lifting eye. There are three mounting lugs for a smoke grenade launcher above the headlight assembly. (John Adams-Graf)

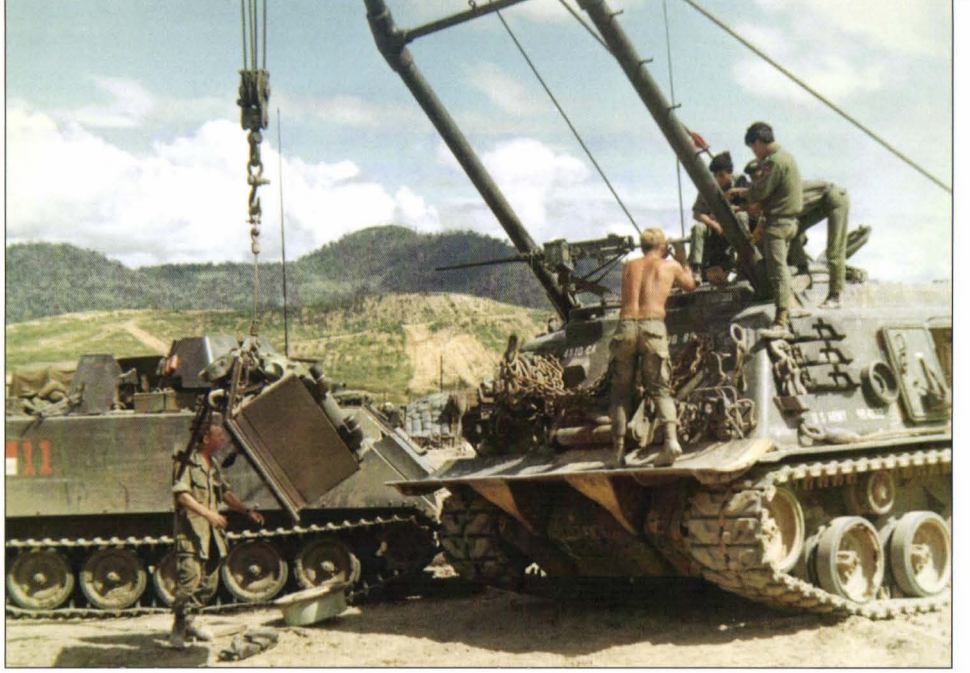
This M88A1 has a louvered door for the APU compartment but lacks the smoke grenade launchers on the glacis and the smoke grenade boxes above the spare track links. (TACOM LCMC History Office)



Members of the 3rd ARVN Cavalry, training with Troop A, 1st Squadron, 10th Cavalry, 4th Infantry Division, use an M88 in a repair operation at Fire Base "Action," west of An Khe, on 27 October 1970. Several chains and clevises in a variety of sizes have been stowed on the front of the retriever. (National Archives)

In preparation for Operation Desert Storm, during a training exercise a Marine Corps M88A1 in Kuwait uprights an overturned M-60A1 main battle tank. The exercise, part of Operation Desert Shield, honed the skills of the retriever crew, and demonstrated how well the M88 design matched the vehicles it was intended to recover. (Marine Corps).

An M88 of the 11th Armored Cavalry has thrown a track and has become stuck as a result.



During joint exercises with the 3rd ARVN Cavalry in October 1970, members of Troop A, 1st Squadron, 10th Cavalry use an M88 to lift an M113A1 ACAV engine.

"Cherry Buster" – an unusually camouflaged M88 operating in Vietnam – moves past ARVN soldiers on patrol near Cu Chi on 28 January 1966. The M88 was operating with the 25th Infantry Division. (National Archives)

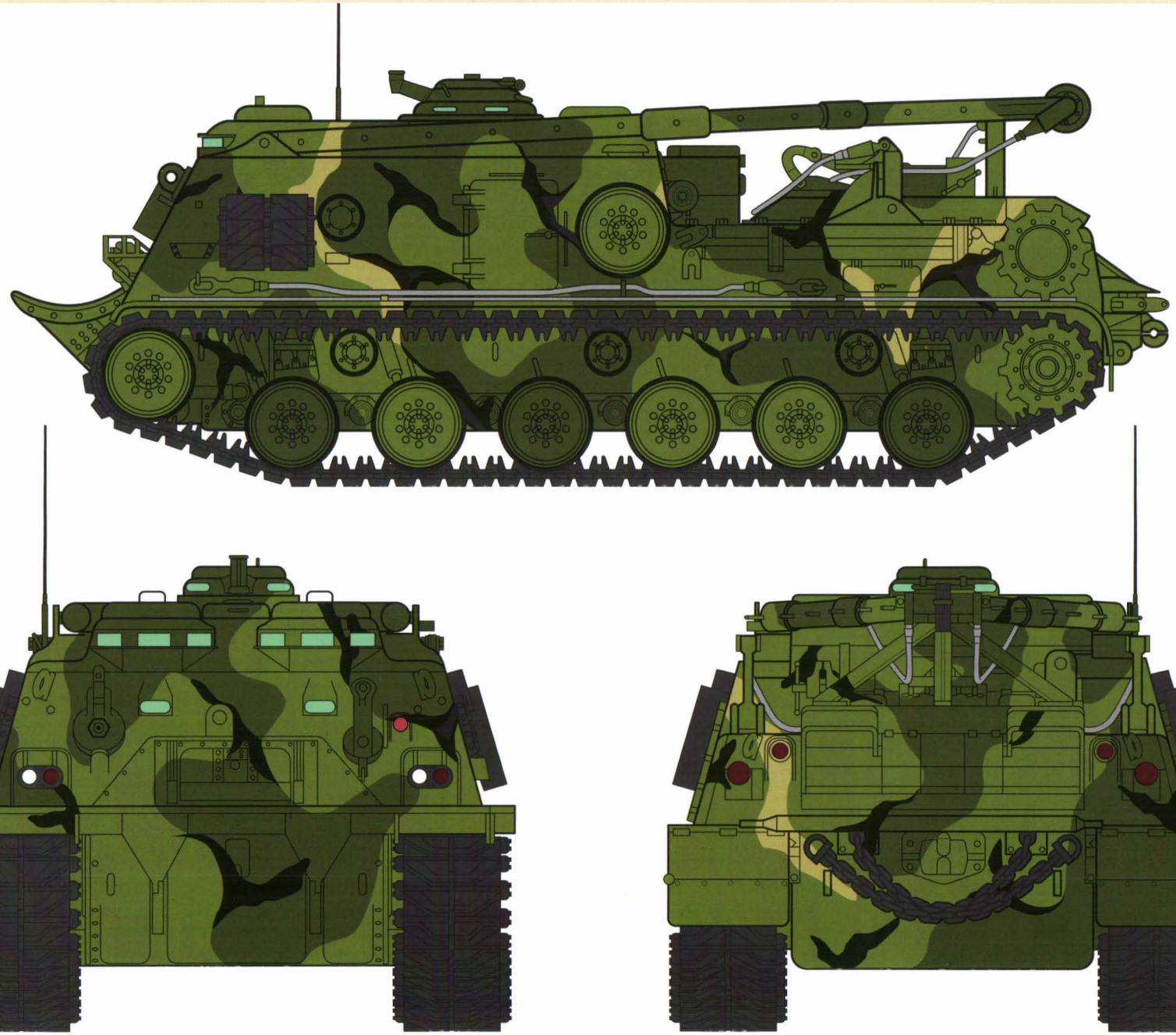
In order to cope with the increased weight of the M1 Abrams, the M88 was upgraded to the A2 configuration, which features improved braking, lifting, and powertrain components. (TACOM LCMC History Office)

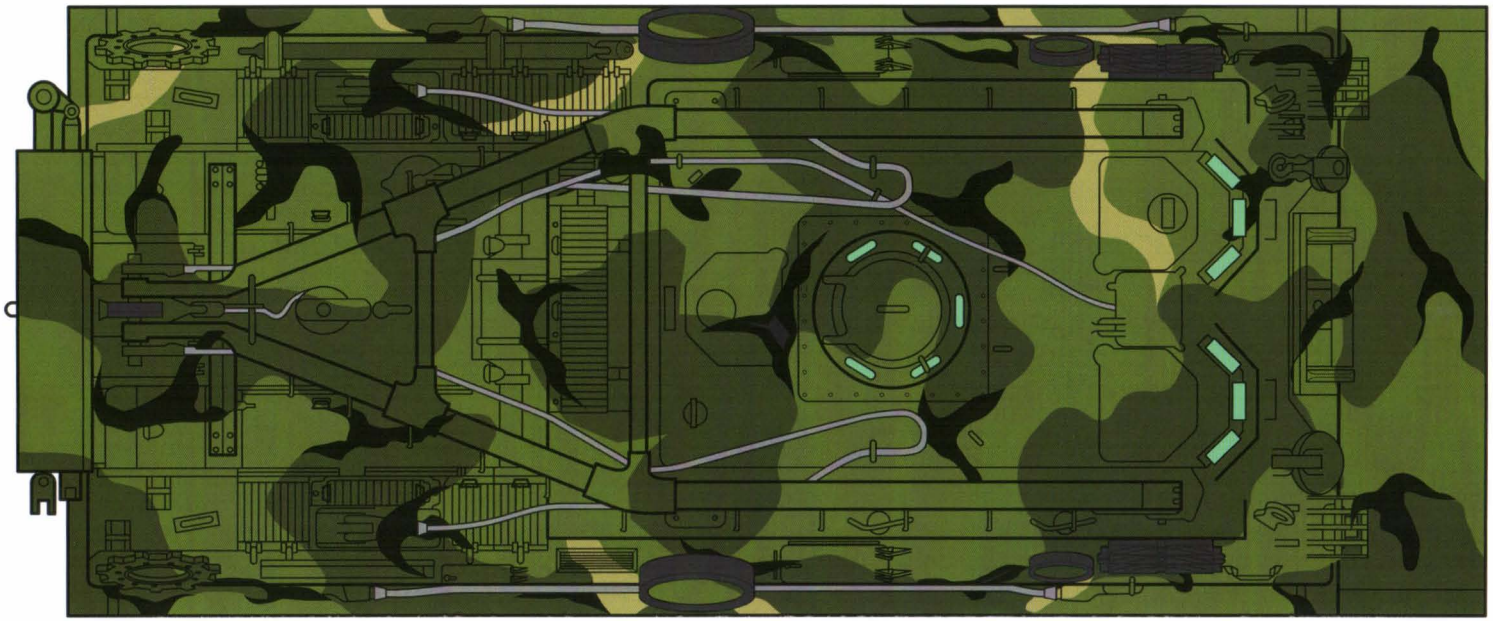
Color Distribution FS595A

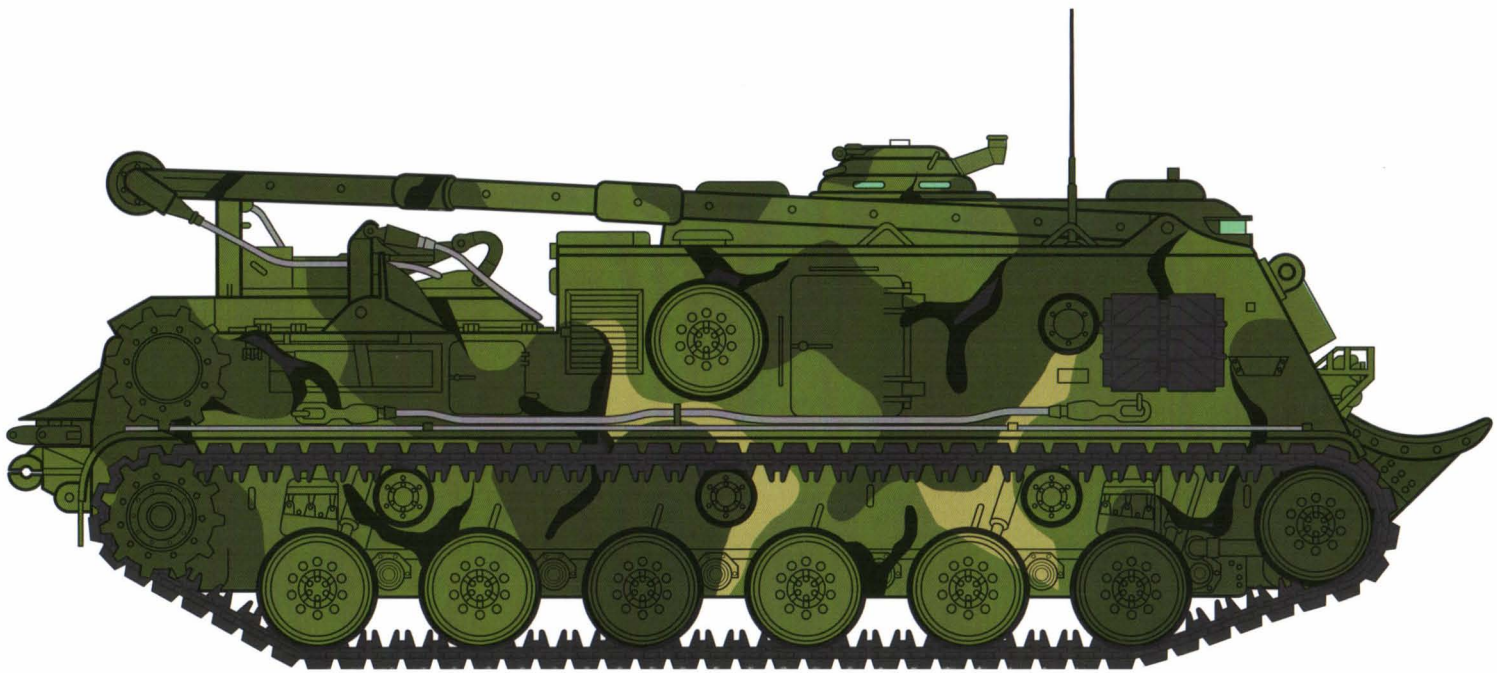
Condition	45%	45%	5%	5%
Winter US & Europe verdant	Forest Green 34079	Field Drab 30118	Sand 30277	Black 37038
Snow – temperate w/trees & shrubs	Forest Green 34079	White 37875	Sand 30277	Black 37038
Snow – temperate w/open terrain	White 37875	Field Drab 30118	Sand 30277	Black 37038
Summer US & Europe – verdant	Forest Green 34079	Light Green 34151	Sand 30277	Black 37038
Tropics – verdant	Forest Green 34079	Dark Green 34102	Lt Green 34151	Black 37038
Gray desert	Sand 30277	Field Drab 30118	Earth Yellow 30257	Black 37038
Red desert	Earth Red 30117	Earth Yellow 30257	Sand 30277	Black 37038
Winter Arctic	White 37875	White 37875	White 37875	White 37875

The spade on the front of the M88, though sometimes used for minor earthwork projects, was actually designed to stabilize the vehicle during recovery operations. Lowered partially, it could anchor the retriever during heavy drag winch operations. Lowered fully, as it is here, the blade actually was beneath the forward portion of the vehicle. The sagging track seen here is indicative of the weight of the vehicle being transferred from the tracks to the spade. This use of the blade relieved the stress on the M88's torsion bar suspension during heavy lifting operations. It also provided a firm, stable footing for the vehicle during the lift. (Patton Museum, Fort Knox, Kentucky)

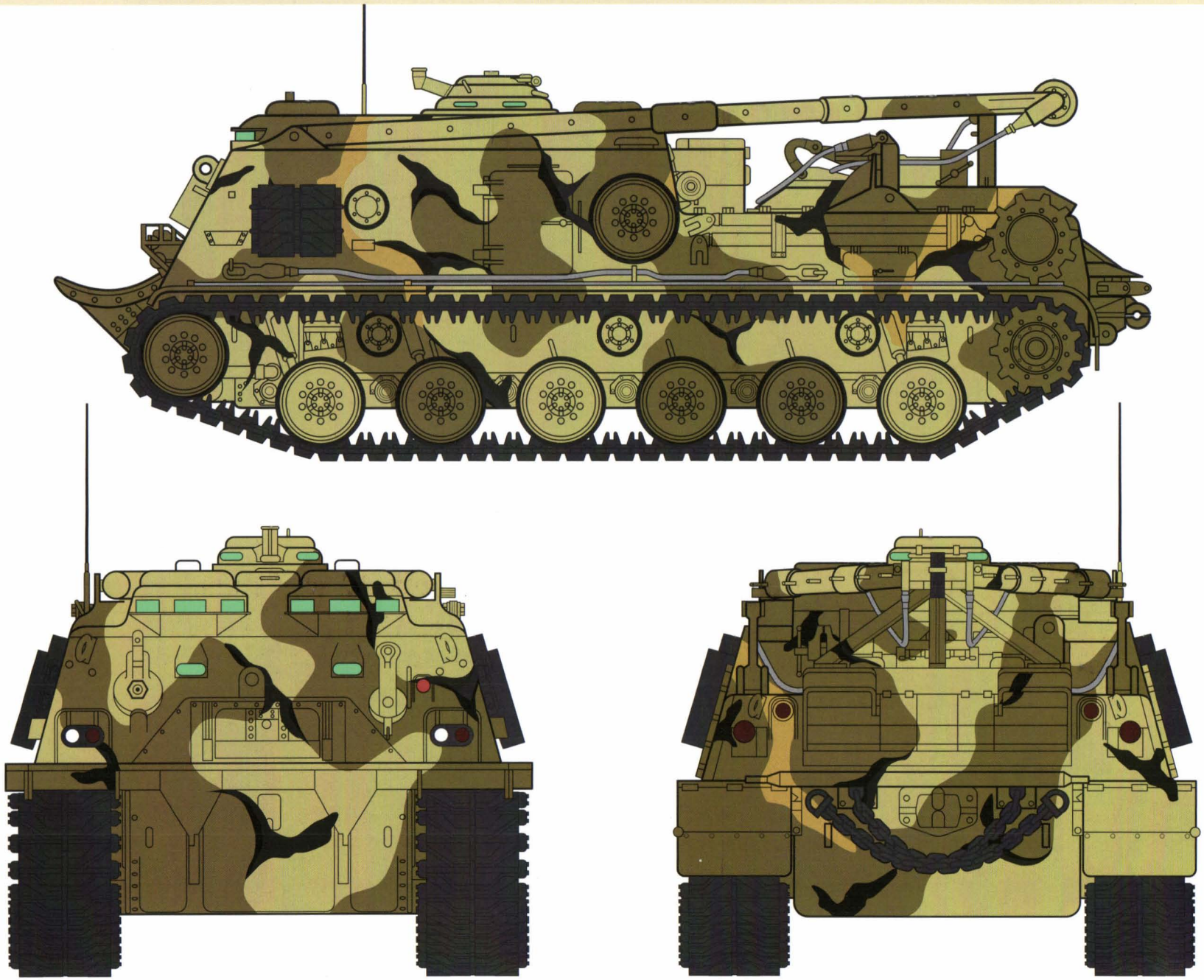
MERDC European Summer Camouflage Pattern

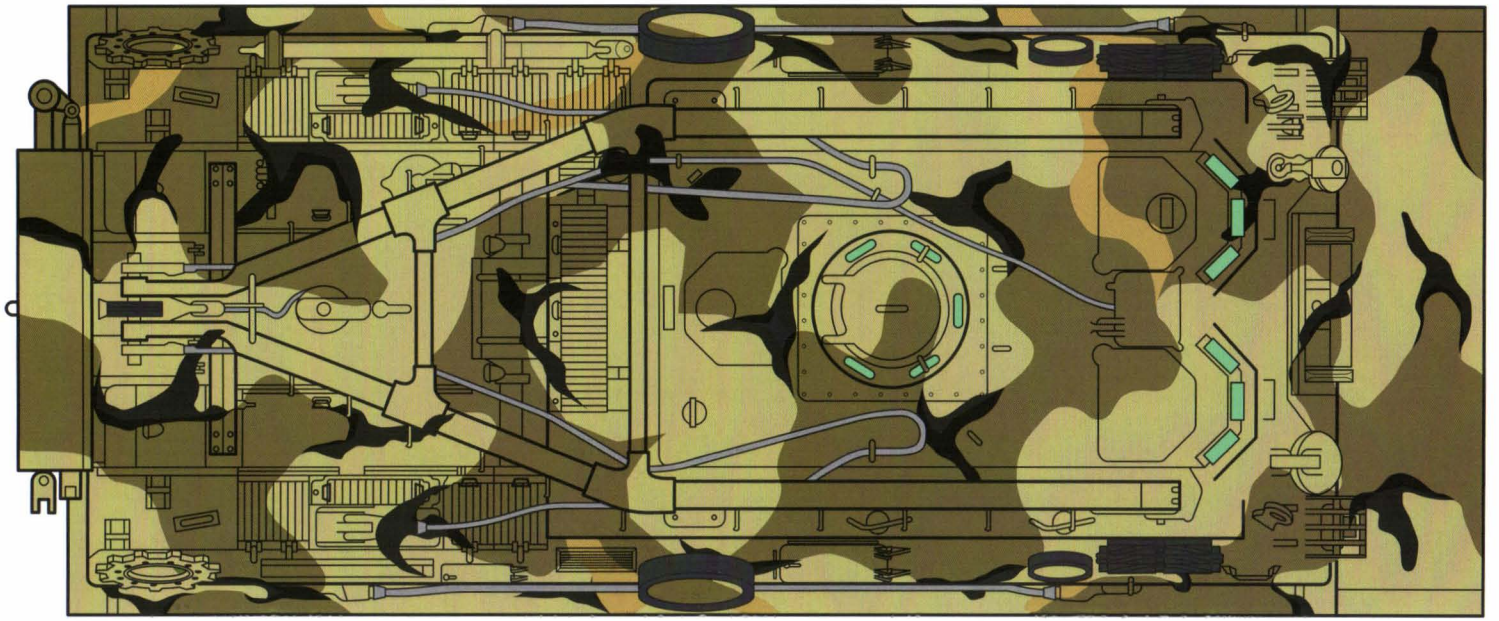


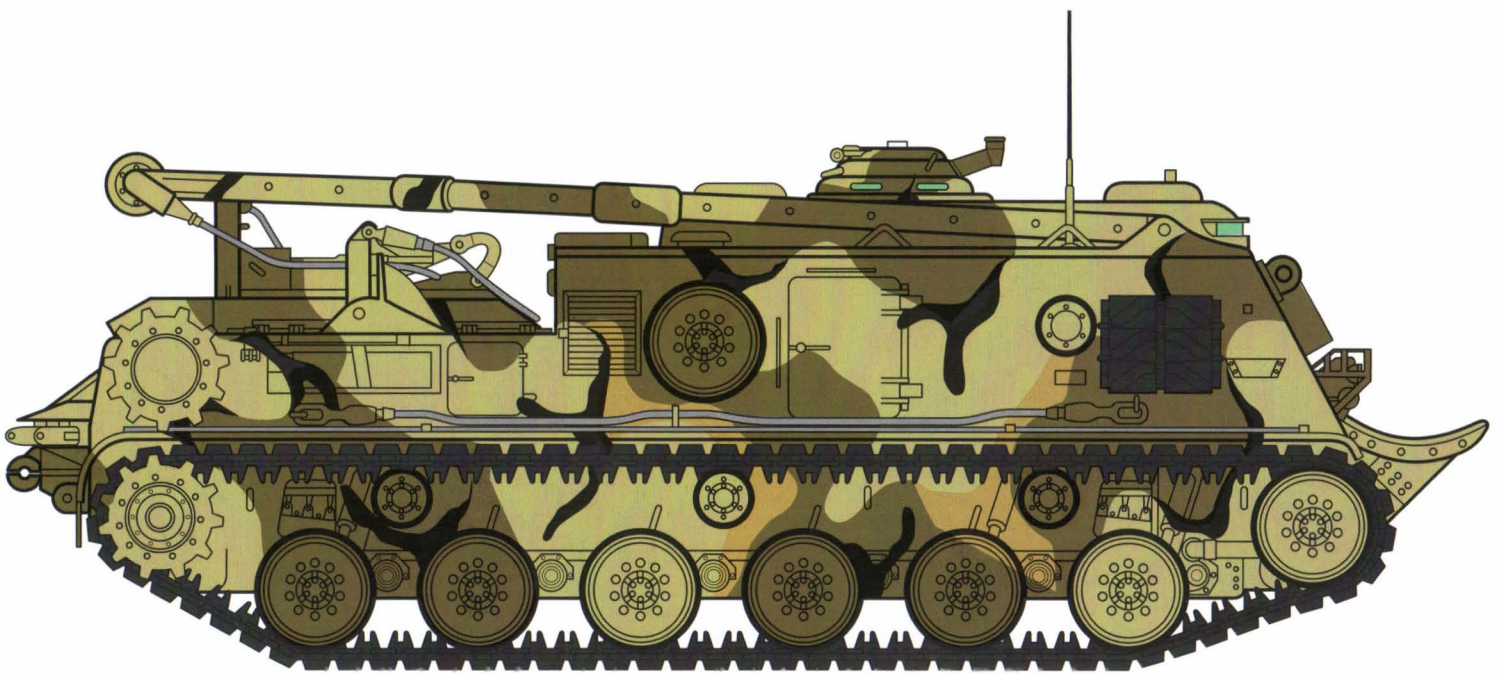




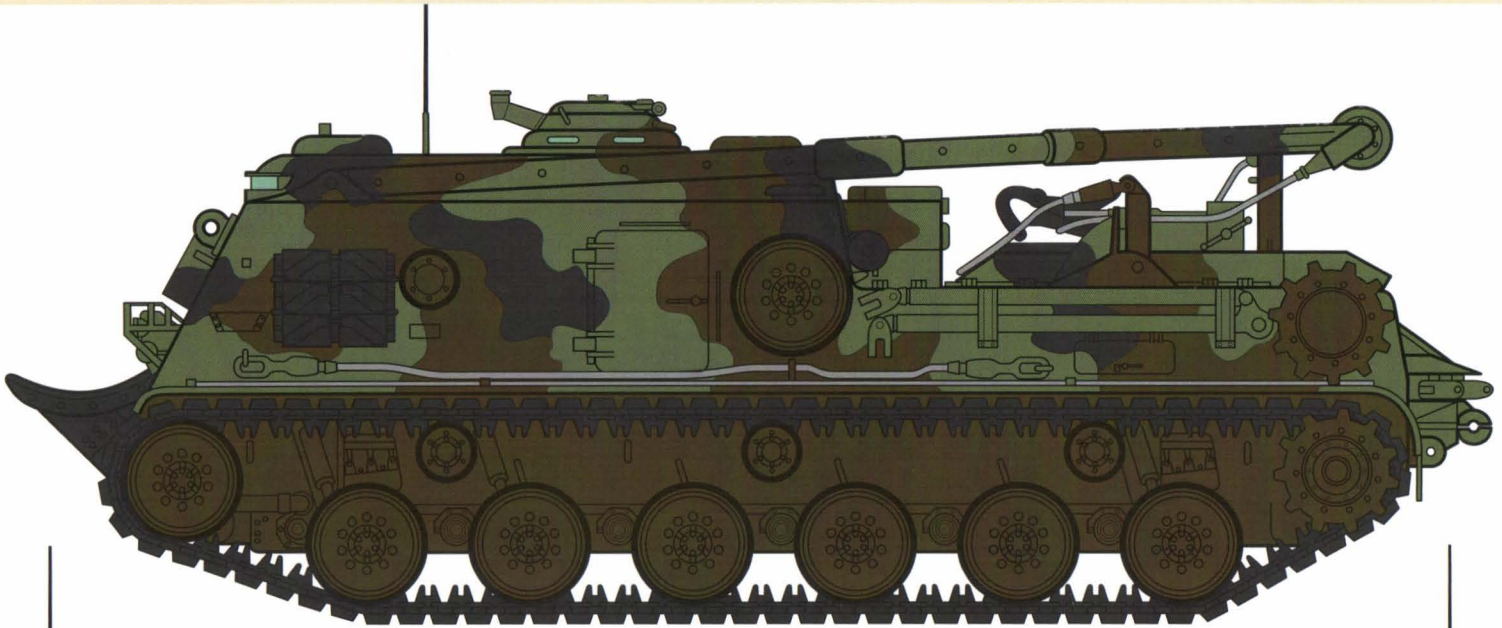
MERDC Gray Desert Camouflage Pattern

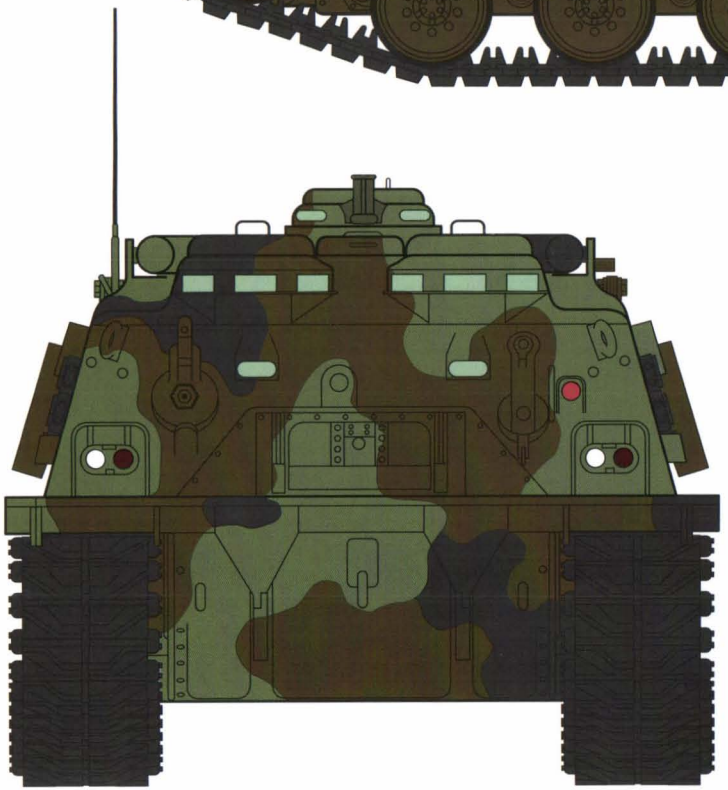


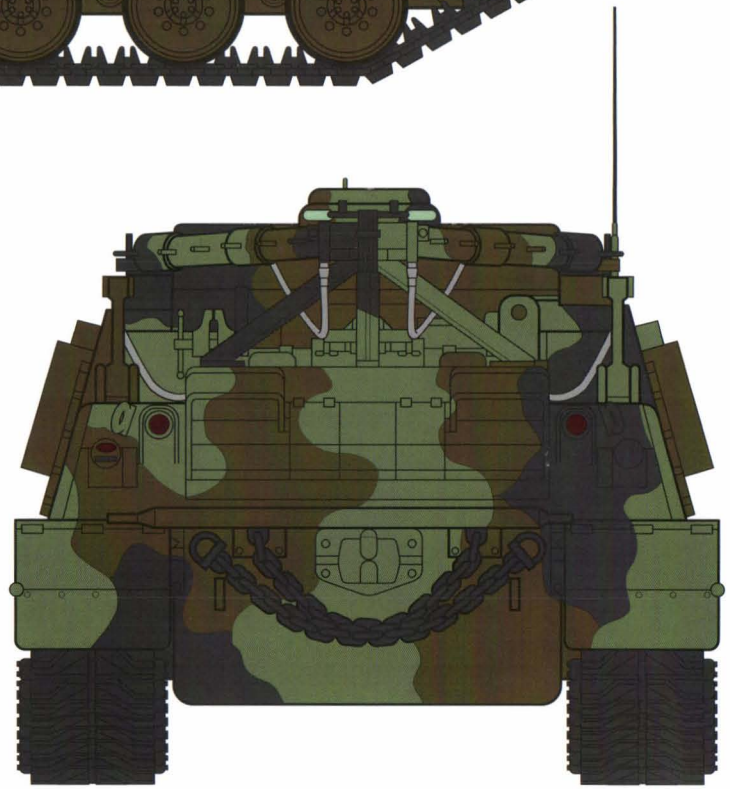


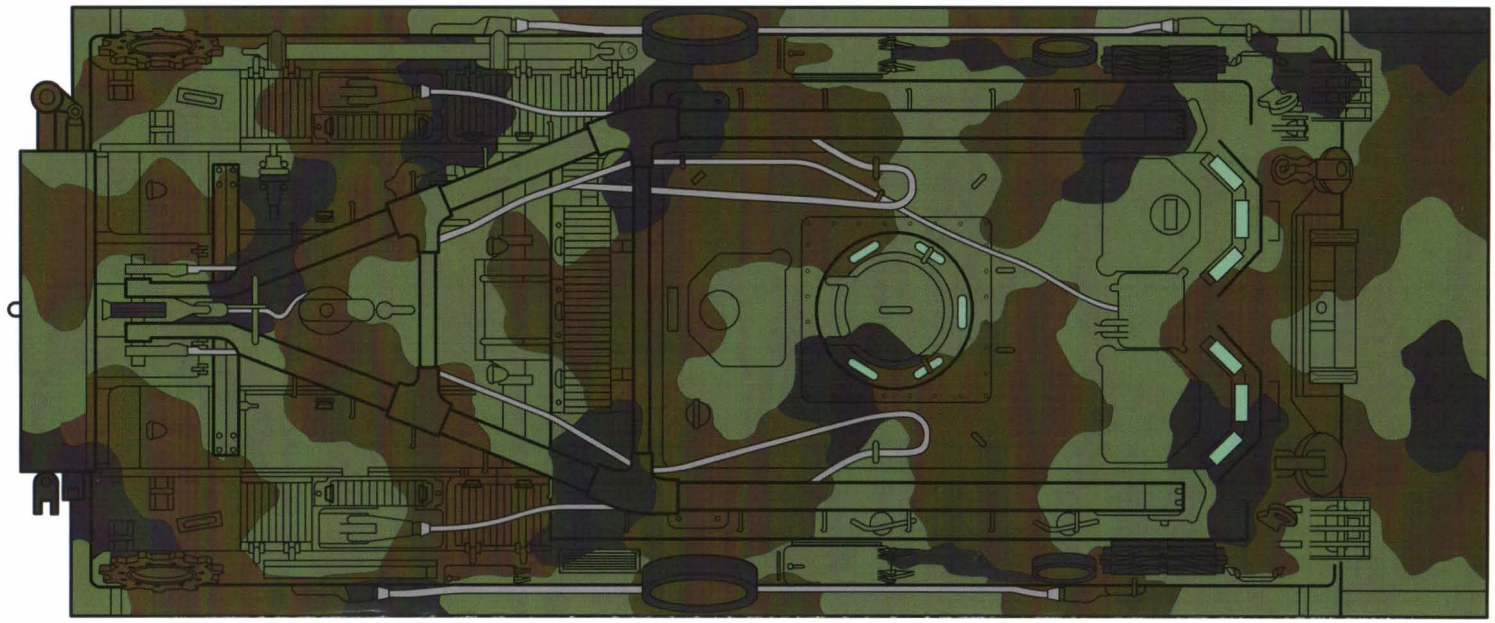


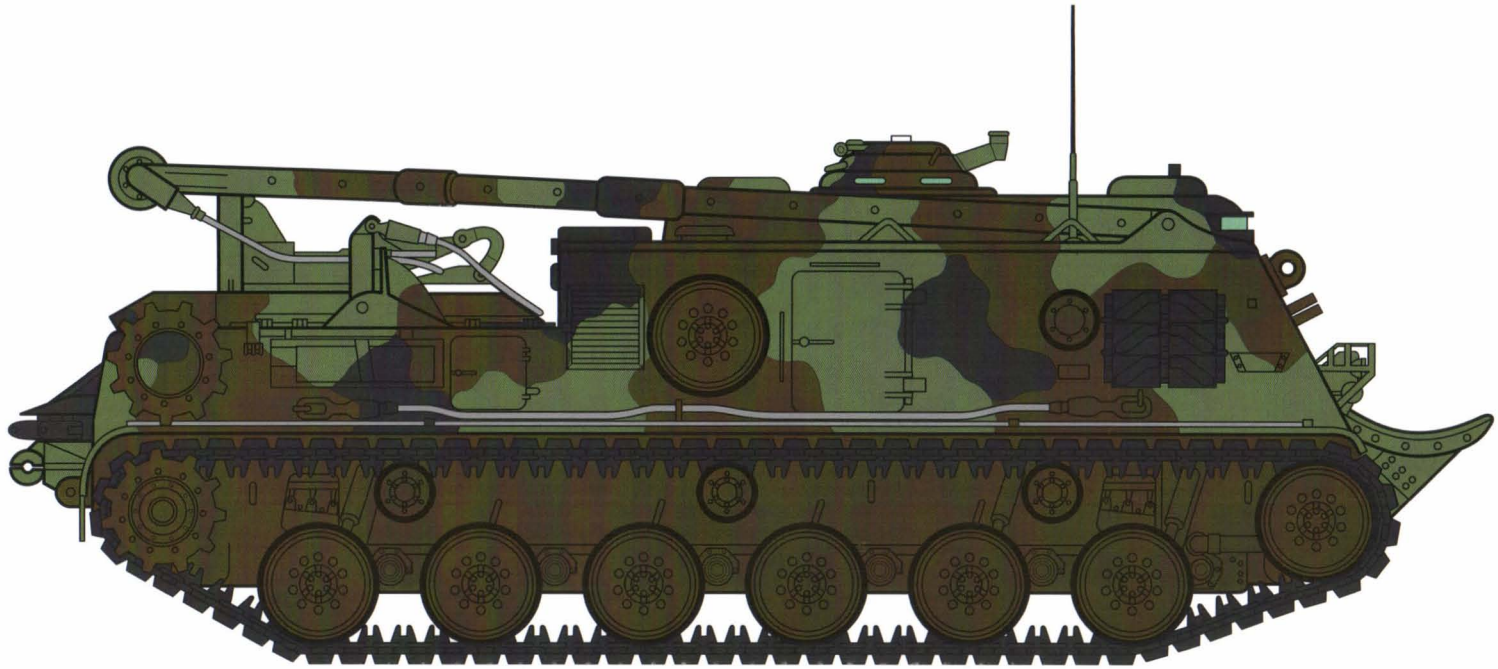
NATO Camouflage Pattern



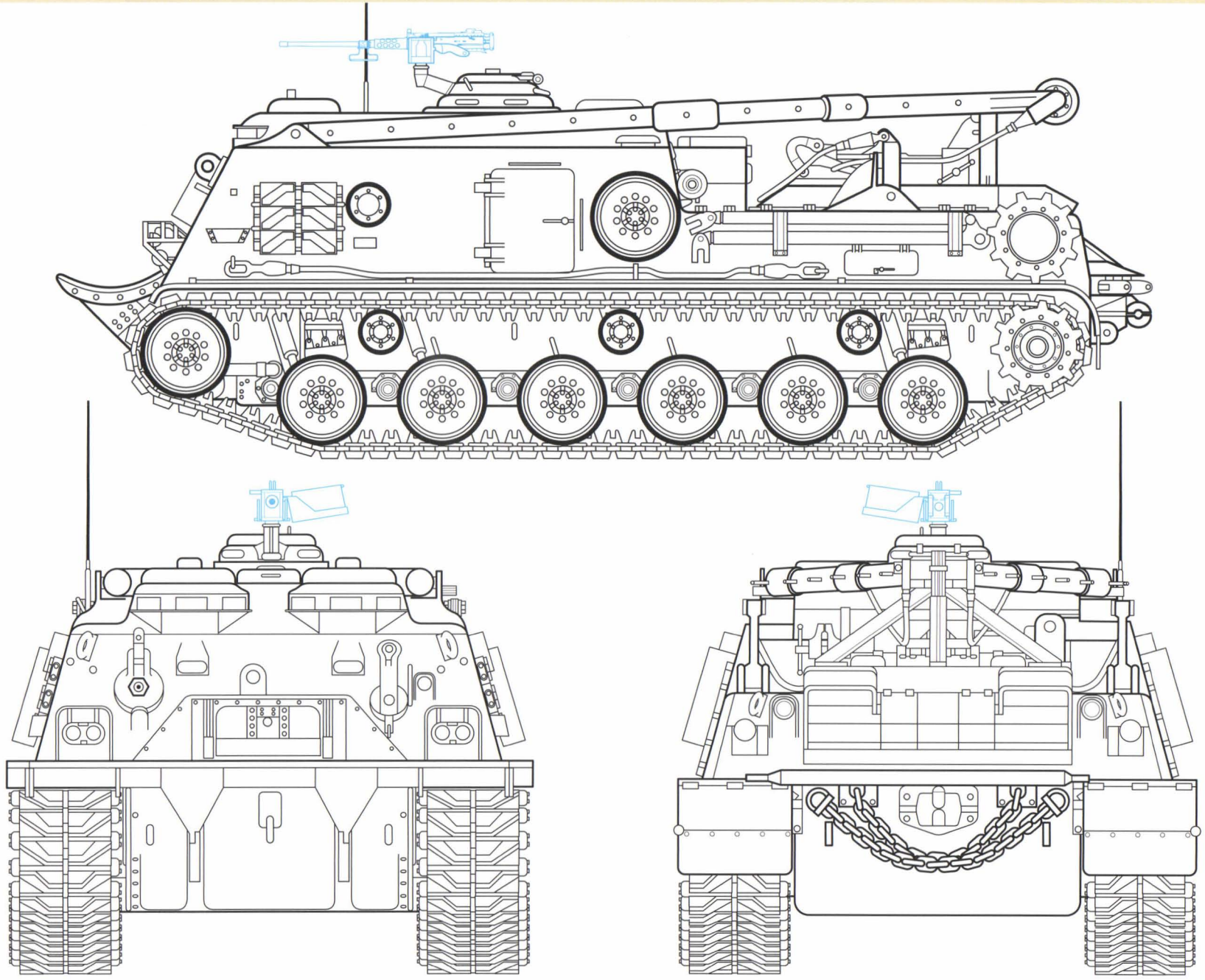


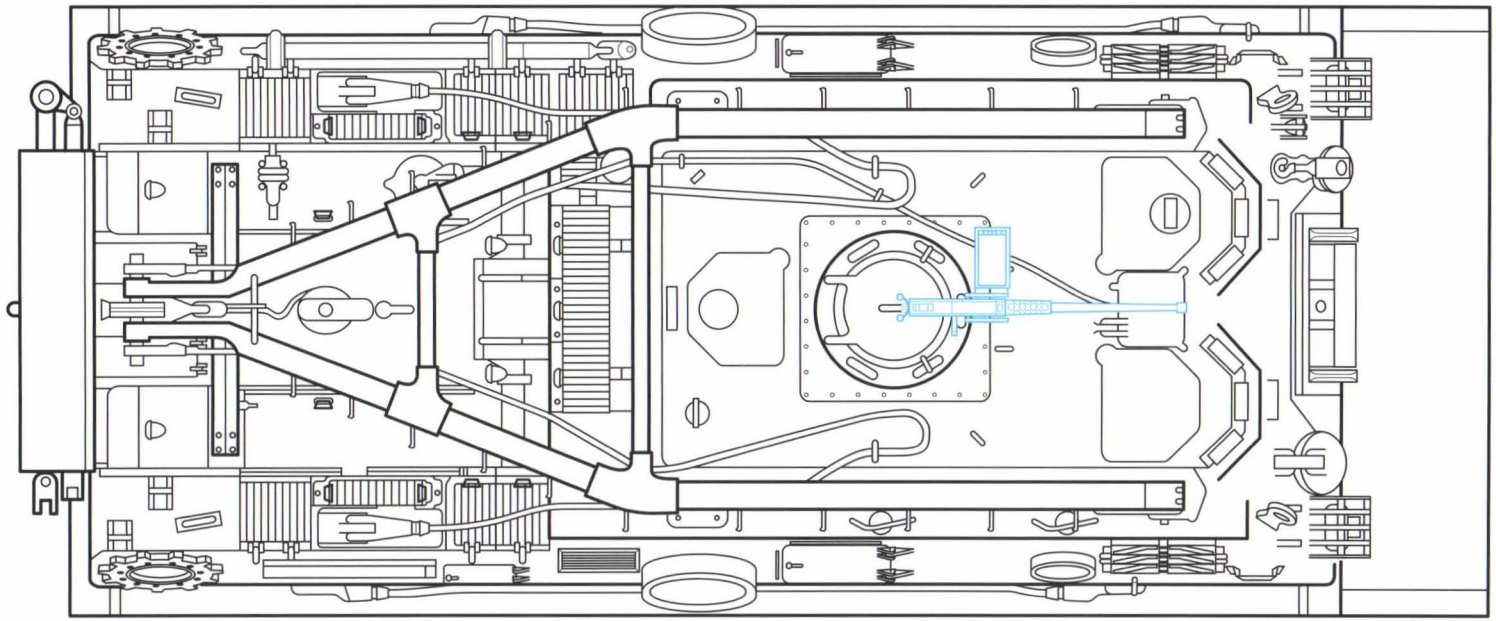


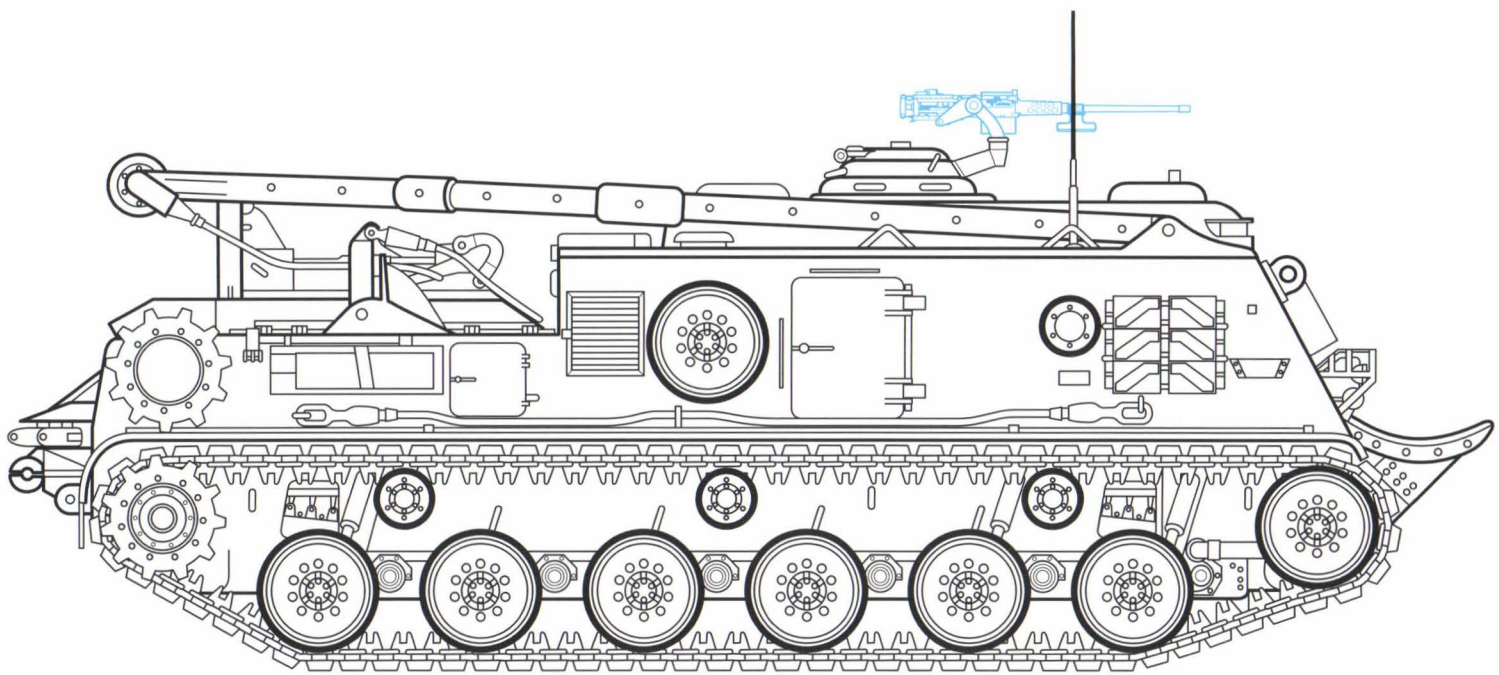




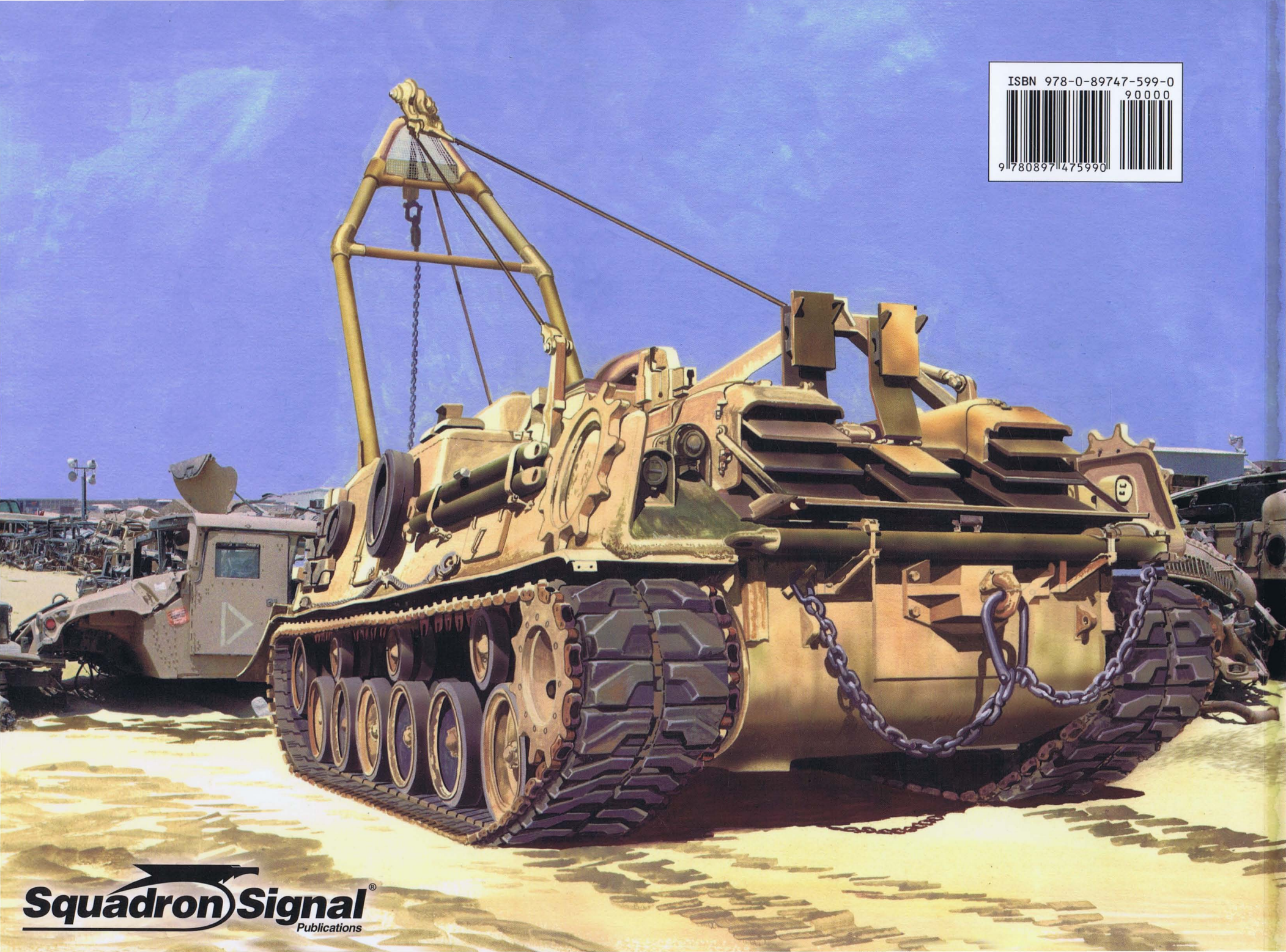
Ordnance Placement







The rear of the hull plates are raised above the sloping rear deck, offering some side protection to the taillight and rigger's light assemblies. A towing pintle is at the center of the rear of the hull below the tow bar, with towing hooks to either side of the pintle. (John Adams-Graf)



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